THE NATION'S INTELLIGENCE

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LONDON:
WATTS & CO.,
5 & 6 JOHNSON'S COURT, FLEET STREET, E.C.4

First published 1936

Printed and Published in Great Britain by C. A. Watts & Co. Limited,
5 & 6 Johnson's Court, Fleet Street, London, E.C.4

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CHAPTER I

IS THERE AN INTELLIGENCE CRISIS?

MR. ALDOUS HUXLEY has quoted somewhere the dictionary classification of Intelligence as Animal, Human, and Military. This book is not concerned with animal intelligence and discusses military intelligence only in so far as militarists still share with ordinary human beings the privileges of British citizenship. The type of ability described here is further limited to what is measured by standard tests of general verbal intelligence. This is the only sense in which the word "intelligence" has a contemporary public meaning. For the edification of their personal prejudices some may choose to define it as the ability to get rich quickly, or discomfit their neighbours, or play chess, or introduce Latin tags into their speeches, or understand economics. These abilities may deserve public inquiry, but this book ignores them. It is exclusively concerned with the concept of general intelligence as it has been developed by educationists and psychologists during the last thirty years. Tests of intelligence are among the most sensitive instruments that exist in the scientific study of man. It seems proper that an attempt should now be made to summarize what we know, as a result of many thousands of experiments made in the present century, concerning the nature of the intellectual differences

observed to occur within a nation and the light they throw on current social controversy.

1. THE FUROR TEUTONICUS

In destroying that optimistic confidence in invincible progress so firmly entrenched in Europe during the past century, no agency has played a more formidable part than recent scepticism concerning the intellectual vitality of modern democracies. In the twelfth century men were born and remained kings, seigneurs great and small, serfs, and slaves. The inevitability of this was accepted as the consequence of a world outlook based on the Book of Genesis. The world of human society was regarded as a microcosm of the universe. It seemed natural that inequalities of rank and degree should exist within the human species, no less than in the animal population of Noah's ark. Fifty years ago the leaders of European thought were shaking off the barbarian doctrine that men belong by birth to fixed estates. Since then the social philosophy of the Middle Ages has re-emerged as a biological theory of fixed estates in the realm of mind. An influential body of scientific and lay opinion declares that human abilities are inherited as land was inherited in the twelfth century. The sciences of intelligence testing and genetics are employed to demonstrate that ability, like the family name, descends unchanged from generation to generation. It is freely stated that the offspring of the prosperous classes are on the average abler than the children of the poor in virtue of their superior mental inheritance. If this were true, our social functions would be well assorted, and any

attempt to reduce the privileges of the successful might be resisted in the sacred name of the greatest happiness of the greatest number.

The fixity of the orders of creation as revealed in the Book of Genesis has its modern counterpart in the fixity of the average Intelligence Quotients of the various social classes. Figures which show that the average I.Q. of different occupational and social levels descends in regular order from the professional and directive classes to the group of unskilled labour irresistibly remind us of the hierarchy of animals, each of their kind and all kinds different, which we find in the biology of the Bible. We know that the pre-evolutionary biologists were wrong in believing the fixity of animal species to be an eternal truth. We may legitimately suspect that the eugenic view of the fixity of existing intelligence-levels is equally in error when it denies that environmental agencies may affect ability. There is no doubt that the average level of intelligence among the children of the prosperous is significantly higher than among the offspring of the poor. But to argue that this proves the hereditary superiority of the prosperous classes is to beg the question. We can observe and measure intelligence only in the actual performances of individuals on various tests. It has yet to be demonstrated that a better environment does not assist a child to exhibit a higher score on an intelligence test. On the contrary, sufficient evidence exists to show that some part at least of the observed superiority of average children of prosperous parents can be attributed to the economic and cultural advantages they enjoy.

A still further parallel may be drawn between the

outlook of the early mediæval period and that of the present day. Then the secular arm, with the full approval of the Church, maintained a rigid hierarchy of civil ranks and powers. But the force of this savage subordination was mitigated by the Christian dogma of the equal value of the *souls* of men. Only thus was social equilibrium maintained so long. Many of those who now adopt the racialist creed attempt a somewhat different compromise. While paying lip service to the ideal of political democracy, they insist on the unequal value of men's *abilities*. The Christian stress on the value of personality blazed the trail for the egalitarian doctrines of the French Revolution. In the same way emphasis on psychological inequality has inspired in some quarters a reaction to autocratic beliefs about society.

Central Europe is now embracing the doctrine that the Aryan race is specially elected to rule the world by virtue of its innate superiority as the agency of modern civilization. By comparison the other races of mankind are, in Calvinistic phrase, totally depraved. In spite of a specious totalitarian equality, the German communion of Aryan saints is, like all theocracies, thoroughly autocratic. Englishmen and Americans habitually underrate the risk of ideological infection from abroad. But we may well ask if the increasing boldness of the racialist party does not in fact constitute a real ground for concern. In a recent popular work on Sterilization an influential advocate of eugenics used the terms "prosperous," "educated," and "intelligent" synonymously in one sentence to denote the same group of individuals. A famous Christian Churchman, Dr. Inge, and a descendant of Charles

Darwin demand that the State should ease the burden of taxation borne by the wealthy classes, who alone represent the inherited ability of England. Writers of this school do not boggle at a restriction of expenditure on social services, including education. These, they contend, merely encourage the reproduction of a class of physically and psychologically inferior racial types.

During the greater part of the nineteenth century the struggle for existence that accompanied the unregulated increase of population and misery during the Industrial Revolution did not seriously menace those who were comfortably established at the top of the social scale. They bred as fast as any, and they did not fear extinction. Thus, when Malthus, and later Darwin, first formulated their views they gave most concern to humanitarians genuinely grieved at the condition of the poor. To-day the demon of Malthus has been displaced by an equally forbidding spectre who wills to destroy the human race in a different way. Human populations are on the edge of a rapid and considerable decline. In other circumstances this might have reconciled the advocates of the struggle for existence to a more amiable attitude to the lower orders, on whose fecundity depends, after all, the supply of armies for the defence of the nation. On the contrary, it is now alleged that the rich are moving to racial extinction even faster than the poor. This breeds the fear that the increasing numerical preponderance of the poor will greatly reduce the available supply of able persons to carry on the national tradition, and that the prosperous will soon be too few to defend themselves in a democratic society.

In no other way is it possible to explain the interest manifested by certain sections of the governing class in the application of intelligence tests and the scrutiny of the results of secondary school education. Like the "new unhappy lords" of Chesterton's immortal poem,

> "They fight by shuffling papers; they have bright dead alien eyes;
> They look at our labour and laughter as a tired man looks at flies."

2. THE REAL ISSUES

What truth is there in these alarming prophecies? We may concede, by an act of unpredecented generosity, the claim that the children of the more prosperous classes are innately more intelligent than those of the poor. We may further concede the existence of a temporary period of differential fertility—in other words, that the birth rate of poorer classes has not yet fallen to the level of the more prosperous. It may also be true that the annual contribution of the latter to the volume of high ability in the population is declining. But does this mean that the total demand for high ability is soon likely to exceed the available supply? Is there insufficient ability in the rest of the population to compensate for the falling-off in the contribution of the upper and middle classes? This would be so only if we were already utilizing all the available high ability in the population.

To investigate this last issue is the main object of the following chapters. We have to answer such questions as these: Is ability spread equally over all the social groups that constitute the heterogeneous English community? Do all individuals displaying superior ability receive the opportunity to use it to the best advantage of society? Can we feel confident

that, if positions in the State and in the professional and economic life of the country require high talent, they are invariably recruited from the highest levels of available ability? How far does Great Britain resemble Plato's imagined Republic, where individuals occupied the positions for which they were best fitted by natural endowment? If, in fact, there are social differences in the distribution of intelligence, to what are they due? Is there anything we can do to increase the proportion of able individuals, judged by existing standards, and to reduce the proportion of persons of low ability? What are the respective merits of a policy of "selective breeding," and one which aims at the improvement of human environment?

Such questions are not easy to answer, or we should have answered them long ago; but their discussion has hitherto been distorted by imperfect understanding of the issues. They are the happy hunting-ground of High Panjandrums, professional mythologists, and pious devotees of new-old cults. Too often the exposition of modern science for the lay public results in the creation of new objects for worship, not in knowledge of the rigorous but entirely worldly processes by which we increase our mastery over Nature. This book will not have succeeded in its object unless it strips off the veil of uncomprehending awe with which its subject is not seldom invested.

At the very outset we may draw attention to a remarkable contradiction in contemporary social thought. We are unanimous in our desire to raise the entire level of the nation's health, not only by preventive measures, but also by a regimen which will

enhance the physical well-being of those who pass as normally healthy. Public health is an example of a domain in which the end is agreed and controversy is limited to the nature of the means by which it can best be achieved. This state of affairs is relatively recent. Only a generation or two ago many people argued that interference with the health of a community was a violation of the natural law of the survival of the fittest. Natural selection was thought to be an adequate account of the growth of human societies from lower to higher levels of well-being. Writing in 1876, St. George Mivart defined natural selection as a process

> " which under bracing climates, rough living, and absence of medical aid [is] beneficial to a ' community,' however fatal to ' individuals,' by killing off weak members and reducing to a compact community of hardy and vigorous survivors."

The technical achievements of scientists are of good report; but their social errors are notorious. Even before the biologists learned to distinguish between organic evolution and cultural development the public conscience of modern states refused to swallow this monstrous doctrine and acquiesced in a vast endeavour to enhance the physical welfare of nations. A similar reluctance to countenance a policy of public intellectual hygiene continues to be expressed by a small but influential body of biologists and psychologists. Active in the application of mental tests to the children of the nation, they draw the conclusion that its average intelligence is actually declining.

We should have every reason to feel alarm if the substantial improvements in the standard of living, in health, and in educational amenities accomplished in

the last fifty years had failed to avert so dire a calamity. It would be astonishing if the average level of ability was falling while people were finding the means to live longer and live healthier, and to enjoy higher real incomes and the opportunities of a fuller existence; while also the proportion of persons engaged in occupations requiring skill and literacy was rising and that of persons having large families in slum conditions was falling. In fact, there is no cause for alarm. Reckless statements are made which are not based on reliable information concerning the comparative intelligence of different generations. Defying the biologists of Darwin's generation, we did not permit the absence of medical aid to kill off the weaker members of the community, and are, in consequence, a healthier nation. The expectation of human life has increased by more than twenty years, and this year stands at nearly sixty-three. This has occurred in spite of the preventable differential mortality of rich and poor, tending to retard the growth of good health in the nation. There is not the slightest reason to suppose that the average intelligence of the community is decreasing in what is, perhaps, an age of differential fertility. This book will attempt to show that the issue has been grossly misrepresented. Defying the eugenists of our own generation, the common sense of the public has decided that it is vitally important to raise the intellectual level of the masses.

3. THE FUTURE OF INTELLIGENCE

In what follows we have to distinguish between two possible meanings of such terms as capacity, capability,

and intellectual level. Through the progressive extension of educational facilities of the right sort we may hope to increase the knowledge and the cultural attainments of mankind. This would represent a positive improvement in intellectual *efficiency*. It is not the same thing as an increase in general intellectual *capacity*. With exactly the same opportunities, "stupid" people learn slowly and do not learn much, "clever" people learn quickly and can learn a much larger number of things, not only at the same, but also at higher levels of intrinsic difficulty. In practice we can judge the intellectual capacity of an individual only by giving him something to do and comparing his performance with that of others. Instead of using the word "capacity," then, it is more exact to speak of *performance on intelligence tests*, or, more briefly, of *test-intelligence*.

In this sense it is hard to say what are the possibilities of raising the average level of intelligence. They depend upon the proof of two propositions, concerning neither of which have we conclusive evidence. It may be that certain improvements in the environment of individuals lead to better performances on intelligence tests. If this is true, we may look forward to some considerable, but not limitless, rise in the intellectual level of the most depressed classes. Again, there may be a change in the distribution of individuals of high and low hereditary powers, which some postulate as the major factor in the movement of the human race from barbarism to civilized ways of living. We do not know that there are any individuals now living who are superior in organic potentialities to the best individuals who have lived

in the past. On the other hand, it is very possible that great changes have taken place in the *relative proportions* of the superior and the inferior, either over the whole population of the globe or in its local distribution.

We may easily confuse these two issues. An observed inferiority in the average intelligence of a social or national group may be attributed to a racial difference when, in fact, all or part of it may be due to discrepancies of environment. Where this is so common sense indicates a simple rule. Since improvements in the environmental condition of individuals raise not only its efficiency, but also the whole cultural level of a community, it is good ethics to investigate the possible effect of environmental changes first. Merely to alter the racial character of a society does not necessarily enhance the quality of civilized living in respects other than those immediate ones for which the change is made.

Another issue also deserves attention. In the thirty years since intelligence tests were first devised many revisions have been made of the tests themselves, and of our estimates of normal performance upon them. So we cannot yet compare the intellectual standing of successive generations of children. As a later chapter will show, the measurements which we make of the intellectual level of a child depend upon his relation to the entire group of children of his own age, tested with the same test. Let us assume that the intellectual "capacity" of one generation is, in fact, higher than that of the previous generation. If, as is likely to happen, we revise from time to time our estimates of the normal performance of children of a given age,

this will lead to new norms in relation to which the intelligence of each and every individual is assessed. In such a case the proportions of children of relatively high and low ability, judged by their deviation from the average of their group, may quite easily remain the same. Thus factors extrinsic to what is being measured, but inherent in the nature of the technical instrument used to measure it, may conceal a real rise in intellectual performance. The economist is familiar with similar difficulties in the use of index numbers, where changes in the base year forming the origin from which calculations begin render historical comparisons unreliable.

Those who are alive to the fact that we live in a changing world will not forget that our present definition of intelligence cannot last for ever. Intelligence tests measure only what we put into them. If human values change, what subsequent generations put into their intelligence tests may be subtly or markedly different from what we put into them. Nowadays we define " health " and " strength " very differently from our ancestors. Good health is relative to the particular kind of hostile agencies we have to contend with in our environment. A man with a pronounced susceptibility to contract cholera is not on that account less healthy than his neighbours (provided he stays in England), although he would almost certainly have died had he lived in the first half of the nineteenth century. Before the invention of optical glass, to be short-sighted was an ever-present handicap. To-day all but the poorest can buy glasses. The Cost of Living Index Number of the Ministry of Labour would become useless

if a substantial change took place in the standard of living of the wage-earning classes. It would continue to measure *something*, but that something would be either irrelevant or positively misleading. The same thing would happen to our existing indices of intelligence if we were gradually to adopt new ideas of what we mean by "intelligence." The significance of this point cannot be over-estimated when psychologists are addressing an audience not entirely composed of their professional colleagues. We easily get carried away by enthusiasm for a technical device. It is more difficult to see the work we are doing in its proper perspective in time.

CHAPTER II

THE SOCIAL BACKGROUND OF INTELLIGENCE TESTING

THE introduction of measuring devices in psychology and education is of very recent date. The scientific study of men did not begin until the spectacular successes of mechanics had put mysticism out of court and undermined the theological approach to human destiny. Until lately man was regarded pre-eminently as the "knowing agent," the province of knowledge being the world external to him. The decline of this anthropocentric view is associated both with the rise of Rationalism and humanitarianism and with the expansion of organized social and economic activities. At a time when the growth of capitalist enterprise in democracies with rapidly increasing populations called for new knowledge concerning men as workers and citizens, experience in the physical and biological sciences had already suggested that human behaviour itself might be explicable in terms of orderly observation and inference.

Intelligence tests have a threefold origin. During the twenty years between 1890 and 1910 they were devised in three countries at once—France, the U.S.A., and England. The aims pursued, while possessing much in common, were in certain respects significantly different, and later developments have shown wide

national divergences. In France the work of Binet was the culmination of a long line of researches into the nature and treatment of mental afflictions. These began with Itard and Seguin, who were followers of Condillac and environmentalists in philosophy. They were guided by the lofty ambition to restore the feeble-minded to normality by enlightened methods of education. They pitched their hopes too high, for they soon discovered that there are grades of mental defect which responded only to the most elementary forms of social training. Nevertheless this belief gave an indispensable stimulus to the study and care of the mentally afflicted. In 1837 Seguin began to train in Paris a small number of feeble-minded children who seemed amenable to education. His example was quickly followed in England, where in 1840 the first asylum for idiots was founded by Andrew Reed at Park House, Highgate. In 1849 the first State institution for the feeble-minded was opened in Massachusetts.

1. THE WORK OF BINET

Meanwhile methods of classifying different kinds of mental *defect*, as contrasted with mental *derangement*, continued to be vague and subjective, and appropriate forms of training made little progress. Alfred Binet (1857–1911) illustrated in a single lifetime the entire transition from the older standpoint, with its reliance on crude physical diagnosis, to the modern concept of empirical measurements of mental ability. Binet's invention of the intelligence test was a signal personal achievement, but he was not unique. The ground had already been prepared by the growth of experimental

methods in academic psychology, which we are accustomed to date from the opening of Wundt's laboratory in Leipzig in 1879. The revolution heralded by Wundt and his American co-workers set up precise knowledge of individual differences in place of attempts to ascertain the general laws of the mind. An enormous amount of work was done in devising tests of sensory and sensori-motor reactions, such as strength of grip, vision, co-ordination and reaction-time, pain, memory, rapid calculation, and digit-span. Foreshadowing "intelligence" testing were tests of rapid calculation, sentence-completion, card-sorting, and the like. In the U.S.A. Gilbert, Cattell, Kelly, and Norsworthy anticipated, without solving, many of the problems that confronted Binet. The work of Burt in England was tending in the same direction.

Different abilities were persistently attributed to separate "faculties" of the mind, such as "memory," "imagination," "reason," etc., which were the traditional categories of a psychology studied in the armchairs of professors of Aristotelian logic. The outstanding contribution of Binet, assisted perhaps by his ignorance of German psychology and his social experience as a physician, lay in his rejection both of the psychophysical approach and of *a priori* mental categories. Instead he insisted on the need to regard the intellectual life as a whole. It was possible, of course, that one day science might be able to analyse complex reactions of individuals to their social environment into single component elements, defined perhaps in terms of physical, metabolic, or nervous processes. Meanwhile Binet asserted the empirical

justification of tests designed to measure "general" intelligence, as manifested in what we should now call the *social* behaviour of individuals. General intelligence was to be sought in the total response of individuals to situations involving many complex mental processes. Whether this represented a single trait, constant to an individual, and not merely the sum of the separate mental powers tested, was irrelevant to his aims. Strictly speaking, the concept of "general intelligence" is sociological rather than psychological. It denoted what we recognize to be useful in certain of our social activities, not those biological differences that distinguish man from other animals.

After many years of experimenting with different tests, Binet established that the response of children to questions and tasks relating to every-day topics common to all children in a homogeneous environment, and graded according to age, corresponded very closely to what competent judges described as differences in "general intelligence." To find such independent authorities, he went, not to the psychological laboratory nor to the philosopher's study, but to members of professions concerned with the education and training of young persons—*e.g.* teachers, physicians, and various State officials. Largely owing to the movement which he began, psychologists today are less occupied with what goes on in our "*minds*" and more willing to observe how we actually *behave*.

If it is possible to assign a reason for the French origin of intelligence testing, it will be found in the tradition of Rationalist Humanism, which never

died in France and was revived with the Third Republic. But the French have always been more generous in manufacturing ideas for export than tenacious in applying them themselves. Long before the death of Binet in 1911, his discoveries, transplanted to America, had taken root in that fertile soil. Binet had never used his tests on more than a few score of subjects. In the U.S.A. they were standardized on scores of thousands. It will be recalled that France was the intellectual home of Communism. Exported, these ideas flourished abroad, while at home they languished, for until very recent times France remained a nation of small individualist producers. For the same reason French intelligence testing made little progress. It spread like wild-fire in America, mainly because of the needs of its rapidly expanding industry, employing hordes of immigrants from every country in the world, and of the requirements of its new and untried system of public education.

2. INTELLIGENCE TESTING IN THE U.S.A.

The problem that occupied the minds of American legislators, employers, and educationists in the period between the seventies of last century and 1911 was the immigration on a large scale of millions of men, women, and children of every different language, race, and social and cultural background, who came to find work, qualify as citizens, and raise their families in the Land of Promise. It was the prevailingly South-East European and Asiatic character of later immigration that turned the U.S.A. into a melting-pot of races and cultures. The labour market made what shifts it could to absorb these millions into the kinds of

employment for which they were most suitable. With somewhat greater leisure the schools began the formidable task of sifting the filial generations into various grades of educability. Bilingualism and the conflict of *mores* between school and home made existing educational technique obsolete. It became necessary to obtain information about the intellectual status of children by means other than ordinary examinations and tests of acquired knowledge. In the response to intelligence tests the contribution of cultural differences is at least greatly minimized. For this reason American teachers welcomed them as a partial solution of their difficulties.

The story of their development in America is too long to be told here. Apart from theoretical speculation concerning the nature of intelligence, in which the Americans have been no more successful than anybody else, and the enormous proliferation of tests of specific kinds of educational performance, their chief contributions have been the elaborate revision and standardization of the Binet tests by Terman and his fellow-workers (known as the Stanford–Binet Scale), and the introduction of Group Tests. Scientific history was made between 1917 and 1919, when several hundred psychologists were appointed to undertake an intellectual survey of the new American armies. Altogether one and three-quarter millions of men were tested, of whom over 80,000 were examined individually. Imperfect though this work was, and although it was for a long time mistakenly held to indicate an alarming state of affairs, it firmly established the intelligence test as a powerful instrument in social engineering.

3. BRITISH BIOLOGY AND EUGENICS

The response of Great Britain to intelligence tests is more difficult to assess. In this country there is no racial problem, and we have never been compelled by any unusual stimulus to undertake the systematic classification of the abilities of our wage-earners or school children. At first they were used mainly in the study of the subnormal child. Only since the War have English educational authorities made any extensive use of them. But the development of pedagogical theory and practice, which owes a great deal to America, together with recent criticisms of the prognostic value of ordinary school examinations in selecting children for higher education, have persuaded English educationists, though often with misgiving, to employ standardized tests of general ability.

Interest in psychological measurements of this kind is kept alive in England mainly for two reasons. One relates to the English philosophical tradition, represented by the Spearman school, which is described in Chapter VI. The other arises from the fact that this country is the home of the theory of organic evolution. Our scientists have always been anxious to investigate the part played by biological inheritance in social change. The diminution in the rate of English economic expansion that followed upon the industrialization of foreign countries towards the end of the nineteenth century produced an internal problem whose significance was grasped by at least some of the leaders of scientific thought. In a rapidly expanding economic system, there is plenty of room for the social promotion both of members of the already privileged

classes and of new men from lower social strata. The appearance of foreign rivals in the field of large-scale industry and commerce gave this process an unwelcome check, while the pressure of democratic institutions was not correspondingly relaxed. Competition, hitherto regarded as beneficent, became an evil. It threatened to destroy the advantages of family descent.

In the decline of the popularity of *laisser-faire* among the governing classes no small part was played by the perception of this aristocratic dilemma. It explains the rise of monopolies. It explains the eclipse of Liberalism. It explains also why the biological theory of inheritance came as a god-send to the Conservatives. They used it to urge that social stratification corresponds to the distribution of racial types. The rich and successful were rich and successful because they were the offspring of parents of superior hereditary constitution. The poor were poor because their ancestry was genetically inferior. This being so, competition and the reckless extension of popular liberties exercised a dysgenic influence upon the nation. As soon as it was observed that intelligence tests gave evidence of social differences in test-ability, it was tempting to hope that they were due to hereditary differences between social classes.

Sir Francis Galton's *Hereditary Genius* (1869) was the forerunner of this school of thought, which is now known as "eugenics." To provide proofs of his theory that mental differences were mainly due to heredity, he proposed methods for the numerical assessment of such abilities as might be inherited. Galton was the first to construct a hypothetical table of the distribution of general ability in the population,

rejecting the prevailing view that individuals fell into a number of discrete and sharply defined intellectual categories, like idiots and geniuses. In the notion of a "normal" distribution he furnished the hypothesis that differences in intelligence are continuous and arranged in a characteristic manner, so that individuals at both extremes of the scale are rare, the numbers increasing as we approach the average. However, Galton himself made no attempt to assemble actual tests of intelligence.

Eugenists have rendered valuable contributions to the study and measurement of mental and physical traits. They dominate the official attitude to the problem of mental defect and influence very largely the common view of the present population crisis. But their theoretical deductions concerning the rôle of hereditary differences in determining observed differences in human behaviour have recently been subjected to many damaging criticisms, notably by Lancelot Hogben and J. B. S. Haldane. If it is also true that the economic system has gained in recent years a new elasticity, their social recipes will cease to interest us. Since we may look forward to the early disappearance of differential fertility—at least, in its present dimensions—the days of eugenic propaganda are already numbered. In the last year or two more radical elements have been busy transforming the character of the movement. The new persecution of the Jews in Germany has done more to shake the faith of English science in racialist nostrums than a generation of disinterested research. Eugenists no longer regard with the same sceptical disapproval the improvement of the human environment by social legislation.

CHAPTER III

CONSTRUCTING AN INTELLIGENCE TEST

I DO not propose in this chapter to present the reader with a " blue print " to enable him to construct an intelligence test at home. Anybody can operate a home-made radio set, but the administration of an intelligence test is still an expert's job. To say so does not reflect on the intelligence of my readers. The method by which we express the intellectual standing of an individual requires that his performances on a test should be compared with those of his fellows. For that reason the utmost possible uniformity is necessary in the way in which the test is applied.

On the other hand, the reader will rightly want to know how the expert sets about his job. Tests are of two kinds: those which are applied to one person at a time, and those which can be administered to groups of individuals. Individual tests are usually preferred when we want to measure as accurately as possible the intellectual level reached by a given person, to assist us in arranging his educational curriculum and his choice of a career. Group tests are designed to compare the achievements of different sections of the school population, when economy of time is an important consideration and when we want as large a number of data as possible.

The construction of Individual tests, like the modern revisions of the Binet scale, differs from that

of Group tests. In Individual tests the tasks are classified according to the age at which children can normally be expected to attempt them successfully. In Group tests the items are either assembled into categories, or completely mixed up.

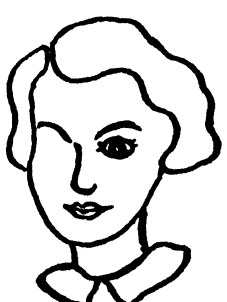
1. INDIVIDUAL TESTS

As we have seen, Binet discovered that in a similar social and cultural environment what the average child of a given age could accomplish, when set simple every-day tasks, corresponded very closely to what independent judges called "general intelligence." For example, experience shows that a child between three and four years of age is generally able to give his name and sex (boy or girl), point to various simple parts of his body, *e.g.*, his eyes, nose, and mouth, repeat two simple numbers like 3 and 7, name several recognizable objects like a penny or a clock, and describe what is represented in some simple photograph-like pictures. If a child between three and four can do all these things, we infer that the level of his intelligence is normal for his age. But, of course, if for any reason he had been brought up in an unusual way—*e.g.*, by very silly or uninterested parents who did not trouble to show him a penny or to utter a number in his presence—we should have to adjust the nature of the questions asked. In examining difficult cases close personal inquiry is essential, and the child in each case has to be tested against a background familiar to him. Binet was the first to point out that the environmental range of poor children might be narrower than that of rich children. It is vital to remember that the "innate capacity" of an individual is some-

thing which cannot be observed directly. Since we can detect it only in the overt performances of individuals, we ought to give them every opportunity to exhibit it by presenting them with tasks of every possible kind.

A child of four can repeat a small number of words of one to three syllables, count a little, point to the longer of two lines—*e.g.*,

and decide which of several faces is the prettiest, as that word is generally used. As he gets older the child normally acquires new and higher abilities. At five he can copy a square recognizably, name a few colours, execute simple commissions like shutting the door, compare weights that are sufficiently different, and so on. At six he should write a little (but only if he is at school or is otherwise taught to write), name the days of the week, distinguish between left and right, put together a rectangular card that has been cut into several pieces, etc. At seven he can tell what features are missing from simple pictures of the human body—*e.g.*,



can do simple addition sums, and knows the difference between certain material objects like wood and glass. Further, more "reflective" accomplishments follow in later years, such as the detection of logical absurdities, building up sentences from a small number of word-clues, or rearranging mixed sentences so that they make sense. He can arrange weights in their order of heaviness, describe the emotional situations represented in pictures, resist suggested resemblances which are not in fact correct, define abstract terms like "justice" and paraphrase common proverbs.

2. GROUP TESTS

In Group tests the items are often classified according to the intellectual operation that they represent. This enables us to see better the general nature of the particular things that children are expected to do. In those tests, which are usually printed in booklets and arranged so that the child writes or otherwise marks his own answers, each sub-section bears a title like "Analogies" or "Similarities." The great majority of Group tests are purely verbal. For this reason they are not suitable for very young children, who are unable either to understand the directions for answering the questions or to read the questions themselves.

Some of the categories of intellectual response tested are as follows :—

(i) *Following Directions.* In almost every domain of social life an individual must be able to carry out a number of simply expressed instructions. Inability to do so frequently indicates either extreme mental retardation or the existence of some degree of emotional derangement. In order to learn we have

to be interested, attentive, show a spirit of co-operation, and be prepared to listen to what older and more experienced people tell us to do. (Learning by finding out everything for ourselves, although recently very fashionable in certain "experimental" schools, is actually a very barren policy.) Nor does a test like this merely measure docility, in a disreputable sense of the word. None of the things to be done outrages common sense, good taste, or self-interest. Following directions is an essential part of the complete process of learning in a social environment.

A simple method of testing how well an individual follows instructions of different degrees of complexity is to invite him to name certain letters of the alphabet—*e.g.*, "Write the seventh letter of the alphabet." (For convenience the whole alphabet is often printed at the top of the page.) Or "Write the letter which is the fifth letter to the left of the letter which is midway between K and O." Or "Find the letter which in this sentence appears a third time nearest the beginning."

(ii) *Opposites.* An elementary sign of intelligence is the ability to distinguish between a thing and another thing that differs from it in the special way that we call oppositeness. A word is printed at the beginning of a line. It is followed by (say) five words, only one of which is the correct opposite of the word at the beginning of the line. The problem is to choose the correct opposite by underlining it—*e.g.*, hot . . . (fire, ice, cold, dark, warm). Here the reader makes acquaintance with two devices very frequently employed in written tests. First the subject is asked to *underline* the correct response. This minimizes differences in speed or legibility due to

differences between individuals in their handwriting. Secondly when we give the subject a list of alternative answers, it both makes it easier for him, by always including the correct answer, and more difficult, by containing some alternatives which might satisfy the less intelligent.

(iii) *Rearranging Mixed Sentences.* Take the sentence

" fuel wood are coal and for burned "

or

" motor-car pocket man his keeps a his in."

These sentences are meaningless until the words have been rearranged, when each is capable of only one meaningful form. Problems like this test our ability to bring order and coherence into our every-day observations. When we attempt to discover the meaning of any part of our experience, what happens is that a number of separate and apparently unrelated perceptions combine slowly or quickly into a *pattern.* This is true when we are puzzling out the meaning of a man's actions in the garden, when we can see only a part of what he is doing or when he is doing things in an order different from what we expect. It is in this way that we put together the pieces in a jigsaw puzzle, find the explanation of occurrences in a laboratory, or try to understand the effects of motoring legislation.

Observe that the reconstructed statements, while they make sense, need not necessarily be true. Our second example makes plain sense, but is false in fact. Some psychologists require the subject not only to give the sentence meaning, but also to say whether the proposition it makes is true or false. In this case

we are testing not only general knowledge, but also often common sense, or a flair for detecting incongruities or impossibilities.

(iv) *Paraphrasing Proverbs.* What the grammarians call figures of speech abound in every language, weakening it, no doubt, as a vehicle for the communication of exact knowledge, but enriching it also by their power to evoke a large number of associated experiences. Proverbial expressions like " A drowning man will grasp at straws " can be rendered more soberly as " Desperate people cling to absurd hopes." A surprisingly large part of the speech, and presumably of the thinking of ordinary people is couched in this form. To understand these expressions is a necessary part of intelligent social behaviour. Originating in every-day experience, proverbs owe their point to the cogency with which they employ striking instances to illustrate general truths, or phases of truth. On the other hand, it must be admitted that the use of proverbs may be characteristic of a certain kind of literary culture, in which wide social differences may exist. To perceive the general truth concealed by a proverb may be a little difficult to a child who has never heard it uttered.

(v) *The Manipulation of Numbers.* Numbers, like words, are symbols. They symbolize fewer things than words; but where they are most useful, as in describing size, order, and relationship, they are capable of a much higher degree of precise statement. Numerical tests generally require the ability to do simple addition, subtraction, and the like; but they are not intended to be tests of arithmetical prowess. The following is an example. " If a man walks east

from his home 7 miles and then walks west 4 miles, how far is he from home?" Here the problem is not merely to add 4 to 7 or subtract 4 from 7. It is to decide which of these two alternative operations is the correct one. Or again, "Town X is 30 miles north of Town Y. Town Y is 15 miles north of Town Z. How far is Town Z from Town X?" A much larger number of children can add 30 to 15 to make 45 than can argue that, since both X and Y are north of Z, it is addition and not subtraction which is the proper operation to perform. The use of quantities is almost universal in modern civilization. Every housewife must be able to compare prices. Nearly every wage-earner has to understand the basis on which his weekly wages are computed. Every branch of natural science employs numbers in treating its data. This is no less true of the scientific study of human nature. As we shall see soon, an objective estimate of the intellectual level of an individual is essentially numerical or metrical.

Another way in which we may use numbers in testing intelligence is illustrated by the following:—

I I — I — I I — I —

Here the test is to recognize the rhythmic principle present, and then to continue the series in such a way as to show that it has been understood. Or take again a line of numbers:—

1 4 9 16 25 36 49 . . . . .

When it is observed that each of these numbers is a "square" it is easy to continue the series by adding the number 64.

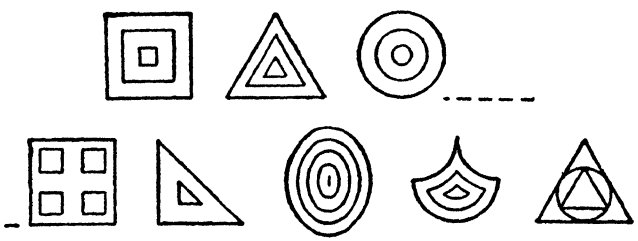
(vi) *Analogies.* A well-attested characteristic of intelligent behaviour consists in the perception of right analogies. For example, a finger is to a hand as a toe is to a foot. Here the intellectual procedure involved is to recognize that a second and totally different part of the body is related to something else in the manner similar to the relation between a finger and a hand. Try the following, putting the answer in the place occupied by the question-mark.

hospital : the sick—— (?) : criminals
better : good——worse : (?)
education : ignorance—— (?) : poverty
evolution : revolution——crawl : (?)

Analogies can be classified as associations of a part with the whole, genus with species, cause with effect, and similarities with differences. Analogical reasoning plays a greater part in the discovery of knowledge than is commonly realized. In the history of science the two most striking examples are perhaps the wave theory of light and the early explanation of " current " electricity in terms of electric fluids. Both the ether of space and the electric fluid of Benjamin Franklin have ceased to be used in a literal sense ; but the metrical entities, like *interference* and *resistance*, to which the analogies of sound-waves and the flow of water called attention, remain as an enduring part of our scientific knowledge.

(vii) *Similarities.* Take the following three things : " Hat, collar, shoe." Think how these are alike, and find in this new series of five things that which is most like the first three : " foot, head, walking-stick, glove, house." Obviously it is " glove," since the

first three things denote articles of wearing apparel. (It is not " walking-stick," which is carried, not worn.) Or take these three : " day, say, gay," and these five : " happy, night, lay, joy, said." The only property shared by all three of the first set of words is that they rhyme. Therefore " lay " is the word in the second series which most resembles the first three. Here is a pictorial example.



One thing only is characteristic of all three figures in the first series. Each represents a certain geometrical shape enclosing two smaller geometrical shapes of the same kind. The only drawing in the second series which does the same is the fourth.

The detection of similarities is, of course, the basis of all systems of classification, such as the grouping of animals into phylum, order, genus, and species.

(viii) *Mazes.* In Group tests children are often asked to trace with a pencil through a pictorial labyrinth to its only exit. The quickest way to solve a maze problem is to envisage it as a whole. Mazes, therefore, test much the same thing as rearranging mixed sentences or completing stories.

(ix) *Story Completion.* " Once upon a . . . there was a . . . who lived in a . . . One . . . as he was roaming

about, he stepped on a . . ., and it stuck in his . . . etc., etc." What words should go into these blank spaces to make the story complete? To find the correct words the subject must be able to make inferences from a few clues, guided by the requirements of the total body of perceived data. The first sentence may be completed in several ways. It could be " Once upon a time there was a man (or boy or girl) who lived in a hut (or forest or palace, etc.)." When we come to the second sentence, it becomes obvious that it is a man, and that he lived in a forest, since he was " roaming about." We guess that he stepped on a thorn, which stuck in his foot.

Only the beginning of the story is given here. As it continues, each subsequent gap in the narrative can be correctly filled in by reference to the trend of the events narrated, which acquire a distinctive character or pattern of their own. When a scientist constructs a hypothesis what he is doing is to make a few observations go a long way. This kind of ability is very often the same as what we call " imagination " or " intuition." If your " intuitions " work with a high percentage of successes you undoubtedly have a large amount of this ability. With or without knowing it you must have observed a great many clues.

(x) *Memory.* We do not usually describe a person as intelligent if he cannot remember things easily. All psychologists are not agreed about the conditions which decide whether we remember one thing well and another badly. But if we can discover something which interests two individuals equally we may legitimately regard the one with the better memory for it as more effectively intelligent. One way of

testing school-children for memory is to read a story to them and then ask them to recall as much of it as they can. Often their task is complicated by the requirement to answer a set list of questions concerning the story. To some the correct answer is "Yes," to others "No"; occasionally, too, some questions are put in to mislead, to which the correct answer is, "The story did not say." Tests of memory are almost always verbal. When we try to examine the ability to remember other forms of learning, we meet with the difficulty that other kinds of learning are specific, the individual being good at some and bad at others.

3. VALIDITY AND RELIABILITY

These, then, are examples of some of the tests which form part of most intelligence scales. When tests are grouped together for the purpose of providing a complete assessment of intelligence, they form what is known either as a scale (Binet's *échelle métrique d'intelligence*) or a "battery," since they are fired off at the subject in quick succession. The construction of a battery like this is not a simple task. In the first place we must have a preliminary belief that the items assembled do in fact test different aspects of intelligent social behaviour at different levels of difficulty. This conviction alone does not make a good test. The psychologist next has to grade the tests in their assumed order of difficulty and try them out on a large sample of children of different ages. It is usual to employ at least twice as many questions in the preliminary test as it is proposed to retain in the final version. Some of them may have to be discarded

altogether, for they may be ambiguously expressed or answered correctly mainly by chance—*e.g.* by younger children as often as older ones. Several try-outs will be necessary before the items, judged by the percentage of all subjects of different ages who pass them, are continuously graded in order of difficulty, and before deciding what time limits are necessary for each task. (In Individual scales time is sometimes not reckoned at all.) In Group tests, for example, which are tried by older as well as younger children within a fairly wide age-range, it is important that no child should be able to answer *all* the questions correctly within the stated time. If, as the phrase goes, " he bursts the ceiling " of the test, it is possible that he could have done still further tasks in the time he has to spare, in which case we should not have measured the entire extent of his superiority over his fellows.

While scales are being standardized in this way, it is also important to compare the standing of individuals on the basis of test performance with independent estimates of their intelligence by teachers and others. Perfect correspondence is neither expected nor desired, because all people, including teachers, do not use the word " intelligent " in precisely the same way. The test therefore draws attention to the common elements in the ways in which most people with experience of children use it. Technically the degree of correspondence between test and other educational ratings is known as the *validity* of the test.

Tests must also satisfy another requirement. They must be *reliable*, in the sense that they yield the same results when administered to children on different occasions, separated by only a short interval of time.

In the case of Individual tests like the Binet few psychologists would be content with less than three applications of the scale. But Group tests are usually given only once. They would be useless unless we had confidence that an experiment conducted on Monday would not produce widely different results from one performed on the same subjects on Thursday. The safest method of assessing the reliability of a Group test is to compare the order in which a number of individuals are rated on Monday with the corresponding order in the same group on Thursday. The statistical index used for assessing this correspondence is called the *correlation coefficient*. It is devised so that if there is perfect correlation, its numerical value is 1, while no correlation at all is represented by 0. The best Group tests correlate to the extent of 0·9, or thereabouts.

Uniformity in the way in which tests are administered is essential if comparisons based upon them are to have any scientific validity. Where there are time limits they must be strictly observed. No help should be given except that provided in the examples in the printed instructions that go with the test. Even inflections of voice and manner must be as uniform as possible. When a large number of persons are tested, it is better that they should be tested by a few outsiders working as a team than by a multitude of different teachers and parents. In this respect Group tests have a distinct advantage over Individual tests. Not only is the social relation between tester and testee much more impersonal; it is also easier to see that conditions are, as nearly as possible, the same in every case.

CHAPTER IV

I.Q. AND SOME OTHERS

A SCHOOL of eighteenth-century poetry took as its model for versification Pope's *Rape of the Lock*. There is no similar performance by any man, living or dead, to serve as a standard by which to assess the intelligence of Englishmen. Human stature is measured by a single arbitrary scale, used also for measuring the height of many other things, which can always be compared with the standard yard-stick preserved in a government building. There is no absolute standard of intelligence in the same sense. If, after testing A, we ask how intelligent he is, we can answer the question only by determining first the kind of performance made by other people on the same test. We then compare his achievement with the *average* achievement of his fellows.

"The nicely calculated lore of less or more" is already used by the layman when he is discussing intelligence. We say that A is rather more intelligent than the average, and B rather less; that X is nearly at the top, and Y nearly at the bottom of the scale. The numerical devices discussed in this chapter aim only at doing the same thing more exactly. The final arithmetical constant which is assigned to an individual may look as if it were absolute, but it is not. There are no absolute units of intelligence. If the

intellectual performances of his fellows change, his remaining the same, he is assigned a different numerical value.

1. AGE-NORMS IN INTELLIGENCE TESTING

As children grow, they grow also in intelligence. If we want to know the intellectual level of a child we must compare him with children *of his own age*, since older children will naturally achieve more than he, and younger children cannot be expected to achieve as much. It would not do to compare the score made on an intelligence test by Peter, aged 10, with that made by Anthony, aged 12. Peter at 10 will most likely score less than Anthony at 12, although it is quite possible that when Peter too is 12, he will score more than Anthony did at that age. If so he would actually be more intelligent than Anthony, a possibility that we could not detect if we simply compared their total scores when they were at different ages.

Peter, then, must be compared with boys of his own age. (In practice we can include girls too, since they do not differ on the average from boys, if they are attending the same kind of schools.) To do this we strike an *average* of all the different scores made by a large number of boys and girls of 10 years old exactly. There are different sorts of averages in use, but the intention of all is the same—namely, to arrive at a figure which can reasonably be said to represent the " central tendency " of the different scores. The average score will not necessarily be the score obtained by the majority of all the children, nor even the score

to occur most often ; but the great majority of the scores are in its immediate neighbourhood, with smaller numbers above and below it. Perhaps the best average to use is the *median*. The median is the score made by the middle child, when all are ranked in order of score. Thus the median score is one attained or exceeded by one-half of all the children.

In Scotland recently every school child aged 10–11 was examined for intelligence. This is the only example of the testing of a complete age-group. Usually we have to be satisfied with less. Experience shows that what is true of a fairly large sample of a population is approximately true for the whole of it. We can either collect children " at random," where they all go to the same type of school and belong to the same class of society, or we can construct a sample in which different types of school and social environment appear in the same proportions as exist in the population as a whole. This latter method is to be preferred if different groups of children differ significantly with respect to circumstances which might affect their intellectual development. If the sample is large enough and well chosen, we can then argue that the average score of any other such sample or sub-group of the same population will tend to be the same.

The average scores made on the Otis Advanced Group Intelligence Scale (Form A) by 10,000 London school children between the ages of 9 years 0 months and 12 years 6 months inclusive, taken from elementary, central, secondary, private, and preparatory schools, weighted for their relative proportions in the school population, are as follows :—

TABLE I

Otis Test Norms for London School Children.

YEARS	9	10	11	12
Months				
0	52	70	85	99
1	53	72	87	100
2	55	73	88	102
3	56	74	89	103
4	58	75	90	104
5	59	77	91	106
6	61	78	92	107
7	63	79	93	
8	64	80	94	
9	66	82	96	
10	67	83	97	
11	69	84	98	

(The Otis Test is useful only with a comparatively narrow age-range, from about 9 to 14 years in the case of English children. Group tests in general are subject to this restriction, but the Binet Individual test (Burt or Stanford Revision) enables us to obtain norms for every age from 2 or 3 upwards to 16 or 18.)

2. THE INTELLIGENCE QUOTIENT

Inspection of this Table of Norms shows that on the Otis Test the average score of a child of 10 years 0 months is 70. A certain number of children will score 70 exactly; the majority, however, will score rather more or rather less, and some a good deal more or a good deal less. To ascertain the comparative intellectual standing of any given child in this test we have simply to find a way of comparing his score

with the score 70. The most common method, although not always the best, is that of the *Intelligence Quotient* (I.Q.). Let us say that a given child of 10, Peter, has the score 75. This is 5 points more than the average for his age; indeed, it is the average of children of 10 years 4 months. We can say that, judging by his intellectual performance, Peter is the equivalent of a child of 10 years 4 months, or has a *Mental Age* of 10 years 4 months. As long as we are dealing with children of his own (chronological) age, this sufficiently indicates the extent of his superiority over the average. But as he gets older he will have a continuously changing Mental Age. We should never be able to compare him with children of all ages.

In order to render the description of intellectual level independent of age, we divide his Mental Age by his actual (*i.e.*, " chronological ") age. In Peter's case this becomes (in fractions) $\frac{\text{M.A. } 10\frac{1}{3}}{\text{C.A. } 10}$ or $1\frac{1}{30}$ or (in decimals) 1·03. To get rid of fractions or decimals it is convenient to multiply this result by 100. Peter's I.Q. is therefore 103. We can perform this division sum at any age, and the result, for the same individual, will always be much the same. The average I.Q. of Peter's age-group, corresponding to a score of 70, would of course be $\frac{\text{M.A. } 10}{\text{C.A. } 10}$ or 100. In the same way the average I.Q. of every age-group is 100, and so also is the average I.Q. of the entire child-population.

This last statement is apt to be puzzling. It does not mean that by some divine dispensation, highly

convenient to the psychologist, the average man and woman achieve an absolute intellectual level of a hundred units of intelligence. As we have said, there are no such things as absolute units of intelligence. I.Q. figures greater or less than 100 simply measure the extent of the deviation from the average. It would be just as easy, though somewhat less convenient, to call the average 1000 or 50.

3. THE INDEX OF BRIGHTNESS

The concept of Mental Age can be avoided altogether if different measures of comparative intellectual ranking are employed. The *Index of Brightness* (I.B.) is a measure of the excess or deficiency of an individual's score above or below the normal score of persons of his exact chronological age, when the normal score itself is expressed as 100. For example, if an individual scores 10 points more than the norm for his age his I.B. will be 110. Similarly if he scores 10 points less his I.B. will be 90. Here we do not need to concern ourselves at all with the Mental Age equivalent to the score in question. We can assign I.B.'s to people of a given age without having to compare them with younger and older people. This is a much more straightforward way of looking at the matter, since our object is to compare children directly with their coevals in age.

Moreover, the I.Q. technique suffers from a grave defect. It is quite unreliable when we are considering older children of high intelligence. Taking the Binet test, a child of 13 or 14 may not only be able to pass all the tests for the highest age tested (16 or 18); he might be able to pass more, if they were available.

But he ranks the same as another who *just* passes all the standard tests. For practically all tests devised so far the score attained *in most cases* does not increase after a certain age—*i.e.*, intelligence *on the average* ceases to grow round about the age of 15 or 16. There cannot be a "normal" score higher than that recorded for 15 or 16, and thus no Mental Age above 15 or 16. All children of 14 who reach a score equivalent to that of the maximum Mental Age would thus have an I.Q. of $\frac{\text{M.A. } 16}{\text{C.A. } 14} \times 100 = 114$. But some may have much *exceeded* this score. Their relative superiority receives no recognition at all. Especially when we use Group tests, this defect often begins to be serious as early as the age of 12. No child of 12, however bright, can have an I.Q. of more than 133, when the maximum Mental Age is 16. On the other hand, a child of 10, if exceptionally bright, may be assigned an I.Q. as high as 160. The consequence is that the average I.Q. appears to be lower for older than for younger children. The error is not removed by the device of using for the calculation of the I.Q. of individuals older than 16 a C.A. of 16 only—namely, $\frac{\text{M.A. } x}{\text{C.A. } 16} \times 100 = \text{I.Q.}$ This may enable us to estimate the intelligence rating of average and sub-average individuals (*i.e.* those with an M.A. of 16 or less); but those who exceed the score reached on the average by all persons of 16 and more receive the same I.Q.—namely, 100.

Various theoretical considerations suggest that neither the I.B. nor the I.Q. is the most reliable measure of the intelligence of different individuals.

It is true that the I.B. is free from the characteristic defect of the I.Q. The I.B. of an individual of given chronological age rises with increasing score without limit. But it is open to the objection that a given increment of score above the age-norm means different things at different ages. It may be a greater achievement to score 20 points more than the average when you are 10 than when you are 14. This consideration limits the use of the I.B. to tests specially constructed so that the frequencies of scores above and below the average is the same at all ages. So far as I know, only the Otis Test satisfies this requirement.

4. PERCENTILE RATING AND STANDARD DEVIATION MEASURE

Two measures of increasing popularity are the Percentile Rating and the Standard Deviation Measure. Both, like the I.B., express the standing of an individual in relation solely to his own age-group. The former ranges from 0 to 100, with an average of 50. If you reach the score obtained only by the top 10 per cent. of your contemporaries, your Percentile Rating is 90—*i.e.* just under 90 per cent. score less than you do. If your score is no higher than that reached by as many as 70 per cent. of the group, your Percentile Rating is 30—*i.e.* just under 30 per cent. score less than you do. The Standard Score is the most sophisticated of all. The Standard Deviation or σ of a group of scores is the square root of the mean of the squares of the differences between the individual scores and the mean score. If n be the number of individual scores and x be the difference between their mean (M) and one of them, the Standard

Deviation is the square root of the average of all the x's in the group—*i.e.*

$$\frac{x_1^2 + x_2^2 + x_3^2 + \ldots}{n}$$

or briefly

$$\sigma = \sqrt{\frac{\Sigma(x^2)}{n}}.$$

If X is the individual's actual score the Standard Score (Z) is given by

$$Z = \frac{X - M}{\sigma}.$$

The Standard Score is in many respects superior to the Percentile Rating, but the reasoning is too difficult to be discussed in a popular work.

The measurement of intellectual level, then, is not entirely free from statistical ambiguities. Nothing does more harm to an infant science than premature popularization without an adequate account of the possible errors, instrumental or statistical, that beset the path of the scientist. Unless we know that scientists can err, like ordinary men and women, and that their instruments and calculations are imperfect, like those we use in every-day life, we shall receive a false and altogether pernicious impression of what scientists do. They are not the votaries of a mystery, communicated in all its ideal perfection from some transcendental source. They are not men gifted with infallibility. Thirty years from now existing methods for measuring intelligence may well appear as crude and unreliable as those of thirty years ago seem to us to-day. But if the expert is not frank about his work

and its limitations, and if the common man begins to worship science as a body of ineluctable mysteries, one of two things will happen. Either the scientist will become complacent and stop finding out new and better ways of doing his job, or else the plain man will revolt from what he thinks is an attempt to impose on him a new religion. Both would be disastrous to the future of civilization.

CHAPTER V

THE RESULTS OF INTELLIGENCE TESTING

1. THE GROWTH OF INTELLIGENCE

IT is a matter of common observation that the intelligence of a child increases, up to a point, as he grows older. It matures at much the same rate as the body as a whole. With an Individual test this means that he will normally pass a larger number of age-tests each year; with a Group test he will make, as a rule, a larger raw score. Intellectual growth takes several forms. As a child gets older the *altitude* of his intellectual performances becomes greater—*i.e.*, he can perform tasks of a higher order of difficulty, which are entirely outside the capacity of a younger person. At the same time, as the result of his greater experience, he can do *more* tasks at each level of difficulty. In other words the *width* or *range* of his intellect increases. So in general does the *speed* with which he can solve a given problem.

Most of us believe that intelligence so defined continues to grow indefinitely with increasing age and experience, right up to the onset of senility. Some will draw attention to the fallacy that mere experience makes men wiser. When a man is fifty he is not necessarily more intelligent than he was at thirty. There are obviously some mental abilities which do

go on growing until very late in life. We can become increasingly skilled at our trade or profession, we may grow more expert and wise in our handling of people. Even here limits are set according to the nature of the activity in question. Certain physical processes deteriorate earlier than others. There is evidence that sensory discrimination is the first to decline. Nor after a certain age is neuro-muscular co-ordination easy to maintain. A surgeon of 70, otherwise showing no signs of old age, will not operate so well as he did at 40. A novelist or a clerk may continue to get better at his job when a miner or a chauffeur is already past his best.

General test-intelligence is probably not so specific an ability as these. Nevertheless it ceases to grow at a comparatively early age. More correctly the majority of us cease to be able to go on performing tasks of an ever-increasing order of difficulty. The *width* of our intelligence may continue to increase, but its *altitude* remains constant. Test-intelligence ceases to show any measurable improvement about the age of 15 or 16.

No conclusion of intelligence testing has caused greater surprise and perturbation in the general public. The American nation was shocked when it was told in 1918 that the average Mental Age of the white soldier in its new armies was little more than 13 years. We now know that this actual figure was quite arbitrary; but there is no cause for alarm in the discovery that a certain human trait reaches maturity so early. The sexual metamorphosis that we call puberty is usually complete by 16; in hot countries much earlier. No one deduces from this that we

remain all our lives at the level of sexual behaviour exhibited by adolescents of 16. At puberty we have, in fact, done nothing that is of the least significance in sexual behaviour. In the same way our intellectual *achievements*, however important they may seem to be at the time, are negligible at the age when our test-intelligence is mature, compared with what they may be afterwards. As we have seen, intelligence tests test educability in conventional school tasks and with existing methods of teaching. In adult life the important thing is not always how "lofty" our intelligence may be, but how we apply it in situations which bear no resemblance to those which occur at school.

The growth of intelligence does not proceed at the same rate at all ages under 16. A child between the ages of 3 and 5 grows faster than a young person between 16 and 20 or an adult between 35 and 50. Unfortunately we lack equal units to measure the growth of intelligence. With our present methods of analysis we are forced to say that the developmental features of the first year of life differ in kind from those of the second, those of the second from those of the third, and so on. In this respect intelligence differs from height. Height is measured on an absolute scale. It is thus possible to say that a child on the average adds 5 per cent. of its final height in a certain year of its life. We cannot safely make any similar statement concerning intelligence. All that we know with any certainty is that with Group tests the rate of increase of score declines from the very beginning of the age-range for which the test is standardized. Growth continues, but less is added

each year, until round about the age of puberty the increase becomes too small and unreliable to be of any significance.

2. CURVED AND CROOKED THINKING

In discussing the calculation of age-norms we saw that it was necessary to strike an average of the scores made by different individuals of the same age, in order to compare any one child with his fellows. Averages have their uses, but they do not by themselves give us a clear picture of the *distribution* of the various values, of which the average is only one. The following two series of twelve numbers have each the same arithmetic mean—namely, 10 :—

(i)	1	2	3	5	7	9	11	12	13	17	19	21
(ii)	9	9	9	9	10	10	10	10	11	11	11	11

Nevertheless the character of the two series is quite different. The first does not even include the mean as one of the actual values, the lowest and the highest figures are widely different, no two figures are the same. In the second series the mean has an actual *frequency* of four, and the other values diverge from it on either side by one only. Common sense suggests that in the first case knowledge of the mean is relatively useless, while in the second it represents very well the central tendency of the series.

Different series will be grouped in different ways round their mean. How are the abilities of individuals in the population, as measured by I.Q., grouped in relation to the mean I.Q. of 100? How many actually possess an I.Q. at or near the average?

What proportion can be assigned other values above and below the mean? How many individuals possess

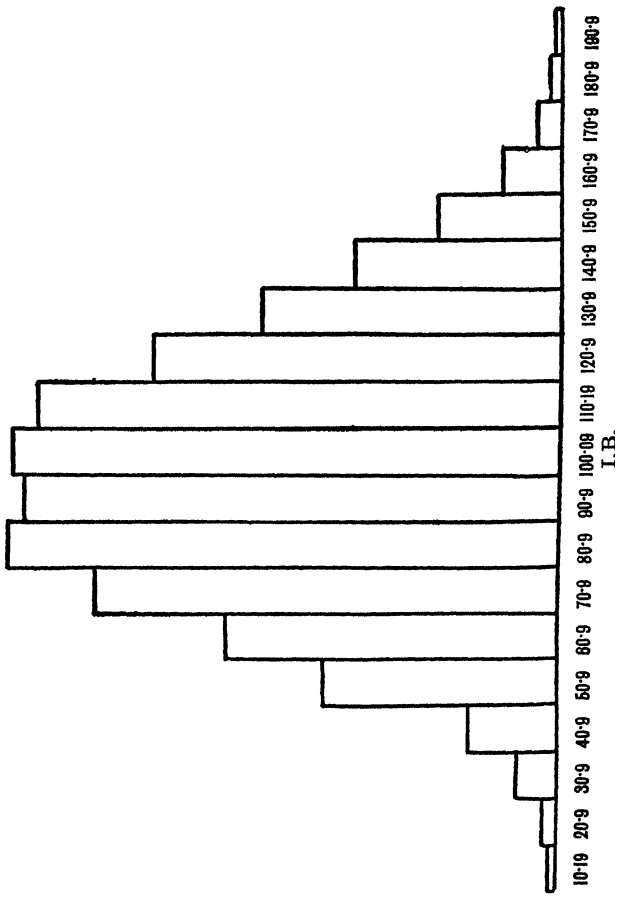


FIG. 1.

exceptionally high and how many unusually low intelligence?

No matter in what units of measurement intellectual ability is expressed the result in broad outline is always the same. When the numbers tested are large, and do not include a disproportionate number of persons known to be superior or inferior, there are always a few who are extremely bright, a few correspondingly dull, a largish concentration in the neighbourhood of the mean, and gradually diminishing numbers at each level between the mean and the two extremes. Fig. I is an example of the distribution found when large numbers are tested. The measure employed is the Index of Brightness.

It is a common habit among psychologists to state that measurements of intelligence always approximate to what is called a "normal" distribution, in which the actual proportions at each level of I.Q. are easily calculable, provided we know the mean and the standard deviation of the series. However, the incompleteness of most existing surveys renders it dangerous to dogmatize concerning the exact nature of the distribution of intelligence. We do not know how it comes about that I.Q. is distributed in the way depicted in Fig. I. For that reason it would be premature to try to force the recorded data to fit a hypothetical curve which is not found to describe adequately the distribution of many other social measurements. Such attempts tend to encourage the view that the distribution of intelligence obeys a natural law, and that the trait itself is not subject to alteration in a world that is otherwise continually changing.[1]

[1] Dr. R. Rusk has recently shown that on the assumption of a normal distribution no less than about 3½ per cent. of Scottish children would be mentally deficient—*i.e.*, have I.Q.'s below 70—

3. THE CONSTANCY OF THE I.Q.

The I.Q. of an individual aims to express his comparative intellectual level independent of his age. In this lies its superiority over the Mental Age. But this advantage would be fictitious if an individual's I.Q. changed much during the period in which intelligence tests are applied. Where children have been re-tested several times in the course of their school life it has been observed that their I.Q. does not, *on the average*, fluctuate more than 5 or 6 points on Binet tests nor more than 10 or 12 on Group tests. Also the larger the interval between test and re-test the greater is the discrepancy. When we are using I.Q. to prognosticate the future intellectual standing of an individual our estimates are not exact. Since, however, the I.Q.'s in a group fluctuate, on the average, in the same direction, the comparative standing of any one individual is not so seriously affected as these figures might imply. On re-testing the *order within the group* is in general hardly changed at all.

The " constancy " of the I.Q. is only relative, but even so it has often been misunderstood. When we say that the I.Q. is constant we mean simply that if nothing occurs to raise or depress an individual's comparative intelligence, it will tend to remain the same. Sometimes it is held to prove that intelligence is not influenced by environment. We know quite well that when some really substantial change takes place in a child's environmental history his I.Q. will

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whereas the best official information, combined with random individual testing, suggests that the actual figure is only about 1½ per cent., or less than half of this figure.

either rise or fall by a greater amount than the rise or fall observed in the group as a whole. Administration of thyroid extract to children with defective thyroid gland will produce a very large increase in their intellectual powers, which continues as long as the dose is maintained and falls off again if it is stopped. A long and severe illness will temporarily retard the intellectual as well as the physical growth of a child. Attendance at a nursery school seems to give children an advantage which persists throughout their school career. It is believed that part of the superiority in the performance of English over American children on the same test is due to the fact that the former begin school on the average a year earlier than the latter. In a later chapter we shall see that older children taken from poor homes and reared for a number of years in more prosperous and cultured families show a significant rise in I.Q.

Nevertheless these unusual changes in environmental condition affect only a few children in any population, so that the constancy of the I.Q. remains statistically true for the group as a whole. In societies where social distinctions are relatively stable no great number of children undergo any change of condition of a magnitude likely to affect their intellectual standing. It is quite possible that the period during which behaviour is most sensitive to environmental differences precedes the age at which I.Q.'s can be reliably assessed. Everything points to infancy and early childhood as the most formative period in human development, but we are still unable to design satisfactory tests for the comparison of very young children. Again, big environmental changes such as those that

elevate the entire standard of living of the whole or a section of the community are not as a rule completed within the short school life of individuals. As yet we have no scientific evidence concerning the effect of long-period economic and social change upon intelligence. The fact that the I.Q. is constant on the average for the great majority of children between the ages of 5 and 15, when nothing significant occurs to disturb their accustomed mode of living, throws little light upon the nature–nurture issue. That issue has its own appropriate methods of investigation, which are discussed more fully in Chapters VIII and IX of this book.

4. MENTAL DEFECT

Until the early years of the present century, when Binet in France and Norsworthy in America made their pioneer inquiries, mental defectives were popularly regarded as a race apart, sub-men afflicted with physical and mental disabilities which put them " on a lower plane even than the beasts of the field." Gradually it was recognized that they were not a unitary class, but that they could be arranged in a series with absolute idiots at the bottom, and at the top " feeble-minded " people who are just a little more backward than quite a large section of the " normal " population. There is no sharp division of a psychological kind between people known to be rather dull and those whom social and legislative opinion decides to call mentally defective. Mental defect is a legal concept of the all-or-none variety. Either you are certified under the Mental Deficiency Acts or you are not. Such cast-iron distinctions do

not appear so clear-cut to the psychologist and biologist. The great majority of the certified are not characterized by the total absence of some mental ability which all other normal people possess. Those who wish to sterilize mental defectives would thereby produce the only known physical disability which would distinguish all people placed in this class from the remainder of the community.

The habit has arisen of regarding mental defectives as occupying the lowest plane in the gradually varying curve of the distribution of intelligence. It is freely stated, especially in America, that idiots have an I.Q. ranging from 0 to 20, imbeciles 20 to 50, and the feeble-minded or "morons" 50 to 70 (these figures do not hold of I.B. or other measures of intelligence). It is not, indeed, claimed by responsible psychologists that I.Q. is by itself sufficient to diagnose these different grades of amentia. But the contrary impression is widespread.

Nowadays it is doubtful if much is to be gained by stressing the continuity of human intelligence. In the time of Binet it was important that this continuity should be recognized. It encouraged the State to regard defectives as persons not so debased that suitable care, training, and employment could not be found for them. Now that Binet and his followers have won their victory and society has undertaken the task of supporting and training these unfortunates another point of view requires to be emphasized. There can be no reasonable doubt that the concept of a "normal distribution" has hypnotized many people into believing that the proportions of individuals at the lowest end of the intelligence scale are

somehow natural and unalterable. But the continuity of intelligence implied by the normal curve does not mean that there are no determinate agencies which explain the occurrence of certain categories of amentia and decide the relative frequencies of individuals at different levels of intelligence. Views of this kind discourage the search for methods of curative treatment, and thus give rise to short-cut proposals like wholesale sterilization. There is a widespread conviction that little can be done to reduce the incidence of mental defect or to increase the proportion of abler individuals. This reaction against medical research is so conspicuous and regrettable a feature of contemporary social opinion that to-day it may be even more important to stress the *specific* nature of mental defect than to continue asserting the continuity of human intelligence.

The legal distinctions between different kinds of amentia do not correspond at all closely with psychological divisions. According to English law *idiots* are persons unable to guard themselves against common physical dangers, because of a condition of arrested or incomplete mental development existing before the age of 18, whether arising from "inherent" causes or induced by disease or injury. *Imbeciles* possess a less pronounced degree of mental defect than idiots, but are incapable of managing themselves or their affairs, or, in the case of children, of being taught to do so. The *feeble-minded* are in turn less defective than imbeciles, but still require care, supervision, and control for their own protection or for the protection of others. Feeble-minded children are defined as those incapable of benefiting from instruction in

ordinary schools. There is even a class of *moral* defectives who combine a vague amount of mental retardation with markedly vicious or criminal propensities. According to Lewis the estimated average incidence of all kinds of legal amentia, except "moral defect," is 8·57 per 1000 of the general population, or under 1 per cent. The frequency is higher in rural than in urban areas. In every 100 such persons roughly 5 are idiots, 20 imbeciles, and 75 feeble-minded.

Inability to lead a safe independent life in matters like personal movement, occupation, marriage, and health is not a criterion that produces the same results in every section of the community. No adult, not otherwise mentally defective according to the Acts, can be certified unless circumstances are shown to require his supervision by public authorities. The need for supervision is more likely to occur when the person is poor than when he belongs to a prosperous family. The Wood Report of 1929 states that "a mentally defective individual, whether child or adult, is one who by reason of incomplete mental development is incapable of independent social adaptation." In our contemporary social organization a few are happily under no compulsion to attempt to adapt themselves to society by earning a living. As a rule such persons are not classified as mentally defective, even though a "psychological" criterion would decide otherwise.

The curious class of moral defectives is also recruited largely from the less prosperous social classes, where delinquency is more public. They are said to have I.Q.'s that range between 70 and 100, so that they

considerably overlap the ordinary population. In fact, it is not likely that mental defect is a significant element in delinquency. Whether it proceeds from mental disorders of a more comprehensive kind or from neurotic tendencies, delinquent behaviour involves different mechanisms from those that are responsible for mental retardation.

5. WHAT IS GENIUS?

There are no Acts for the Encouragement and Better Utilization of Genius. It has no standard legal or social definition. It would be nonsense to say, as adherence to the strict theory of "normal" distribution would imply, that just under 1 per cent. of the population are geniuses. What we mean by genius has no necessary connection at all with the concept of maximal test-intelligence. The Binet scale is very successful in the diagnosis of feeble-mindedness. Neither it nor any other test helps us in the least to prognosticate genius. The view just expressed—that mental defectives ought not properly to be regarded as standing lowest in a continuous scale of human intelligence—derives support from the unquestionable fact that genius is not continuous with high intelligence. It is true that American psychologists boldly identify maximal test-intelligence with genius. There is even a long series of Stanford University monographs entitled "Genetic Studies of Genius," dealing mostly with intelligence test ratings. But this is merely a regrettable linguistic aberration. It is useful to recognize that persons of abnormally superior talent are not unhealthy "freaks" or "prodigies," and that precocity is not necessarily a

sign of neuropathic constitution or early death. Apart from that the American habit of confusing genius with high intellectual gifts, as measured by existing tests, merely obstructs psychological research into the nature of genius.

The Stanford school have indeed made concessions to a somewhat more common definition of genius. Genius in a man is something that is recognized when he is dead. With this in mind, elaborate attempts have been made to assign fictitious I.Q.'s to the illustrious dead. Terman concluded that Sir Francis Galton had an I.Q. of nearly 200, chiefly because of his known precocity at the age of 5. Cox assigned similarly high I.Q.'s to J. S. Mill, Grotius, Goethe, and Leibnitz. It is bad enough to assign I.Q.'s to people without investigating at the same time the average performance of their contemporaries, and to confuse educational achievement with intellectual level. Even worse is the failure to recognize the very wide differences between the educational standards of different periods in history and the enormous class inequalities in educational opportunity that persisted everywhere until recent times. In the late Middle Ages boys went to the colleges of Oxford and Cambridge at the age of 13, in the eighteenth century at 15. To-day they do not proceed to the University until the age of 17 or 18. A hundred years ago those who showed intellectual promise and belonged to the governing classes could easily have construed Greek at the age of 3 or 4, especially if they had fathers like James Mill. To-day we do not teach children foreign languages, mathematics, and philosophy until they are much older. This does

not seem to be less propitious to the flowering of their intelligence. The tempo of educational processes was inevitably much quicker in an age when the average expectation of life was little over 40 than when, as to-day, it is 63, and in a society where there were many fewer things to be learned.

In the absence of public concern with the problem of unusually gifted children, we have few large-scale studies devoted to their social origins and after-careers. Terman's monumental investigation of 1000 Californian "geniuses" is still proceeding. However, it is only 13 years since it began, and few of the subjects have yet more than started adult life and occupations. From what we know of their choice of occupations it would be idle to pretend that many will make any profound impression on the life of their period.

The only other extensive research into the after-careers of gifted individuals is that of Gifford, who in 1928 compared the relative intellectual ranking of 3806 employees of the American Telephone and Telegraph Company with their salary records over a period of 30 years. His subjects had not been given intelligence tests; instead Gifford relied on their achievement in college scholarship examinations. The top 10 per cent. of the group in college achievement constituted 17 per cent. of the group with the highest salaries, the bottom $33\frac{1}{3}$ per cent. contributing only $4\frac{1}{2}$ per cent. of this group. On the whole high-scholarship men went up steadily in salary, while low-scholarship men either stayed where they were or even in some cases suffered reductions. It obviously pays to have a high I.Q., or to take a high place in a scholarship

examination, provided always that you can obtain employment in conditions which permit of successive increments of income. It would be nonsense to assert that genius, in the unadulterated English sense of the word, carries the highest economic rewards which society can bestow.

CHAPTER VI

THE MEANING OF TEST-INTELLIGENCE

IT is a paradox of intelligence tests that, while they are very widely employed and regarded as amongst the most exact of psychological instruments, there is little unanimity about the way in which people define what they measure. When we ask what is the meaning of test-intelligence we can answer the question in at least four different ways. We may content ourselves with enumerating what goes into the tests, and describe them as giving evidence about these things. Alternatively we may define intelligence in terms of the purposes it is thought to serve in the life of organisms. Thirdly we may ask how different aspects of intelligent behaviour, as tested, are related to one another; we may even speculate about the inner physiological correlates of outward intelligent behaviour. Lastly we may seek to discover how test-intelligence is related to the social life of our time, and to differences between individuals in their social relations, occupations, ideals, etc. We may regard tests as specifying certain social requirements mainly in the fields of education and employment. The first view may be called purely *descriptive*, the second *teleological* (sometimes misnamed *biological*), the third *structuralist*, and the fourth *sociological*.

1. THE DESCRIPTIVE VIEW

No definition of test-intelligence can be true unless it refers to what is put into the tests, and to that alone. Whatever we may think of the purposes it serves, its internal structure, or its social significance, we ought always to speak of responses to specific published tests rather than of "intelligence" as you or I may define it in the privacy of club or pub. No scientific data are available for public inspection except for tests of the kind described in Chapter III, of which there are numerous varieties in the market. Since they differ in construction we cannot properly compare results due to one with results due to another without careful preliminary inquiry. The strength of the descriptive view lies in its excessive caution. So also does its weakness. We simply cannot rest content with knowing that tests measure performances on certain specified tasks. We want to know why such tasks are selected in the first place and why our performances on them should possess any general interest.

2. TELEOLOGICAL VIEWS

There is an ingrained habit amongst psychologists of the older school to ask *why* we have intelligence at all and what *purpose* it serves in human life. These questions have their interest, but not to the scientist. Science is concerned with *how* things behave, not with *why* they behave as they do. Nowadays we know a great deal more about how Nature behaves; but we are much less confident about why she does so. In

practice, "why" theories can never be put to any crucial test, and so we are at liberty to invent as many as we please. Teleological definitions of intelligence are numerous, contradictory, and often meaningless. They usually take the form of defining intelligence as an adjustment or adaptation to new situations, where adaptation or adjustment produces changes that are "useful" or "biologically advantageous." But biology itself, as practised by biologists, has given up the attempt to discuss the behaviour of animals from the point of view of deciding whether it is "advantageous" or not.

The belief that high test-intelligence is biologically advantageous is easily shown to be absurd. In any intelligible sense of the words, it is biologically advantageous for the human race to continue. Increasing numbers of persons either have no children at all or have families of only one or two. If all were to behave in this fashion, human populations would rapidly extinguish themselves. Observation shows that "only" children and children in very small families have a much higher average test-intelligence than children in large families. A common interpretation of this fact is that more intelligent parents restrict their families, while the less intelligent continue to procreate. If this is so the highly intelligent, as measured by existing tests, are leading the movement to racial extinction. In the light of this argument can we plausibly maintain that test-intelligence is biologically advantageous? On the contrary, it would appear that the less intelligent people are, in this sense, the more do their actions promote the perpetuation of the human race. In fact, we are entirely

unjustified in defining intelligence in terms of its purpose or end. All that we are entitled to say is that both lay and scientific opinion tends to define intelligence in terms of contemporary social requirements, as they are commonly interpreted. Society is not yet alive to the need to define as intelligent or unintelligent actions whose consequences are remote. But the need to supply and to select trained individuals to carry on the day-to-day life of the community is urgent and easily recognized. It is to find such persons that intelligence tests have been constructed.

It is customary in England to define intelligence as " sheer innate capacity." This linguistic usage is also open to the gravest criticism. It is unpleasantly reminiscent of the discredited Aristotelian doctrine of essences, which we now recognize to be mere tautology. Intelligence tests relate only to the *observed performances* of individuals on the tests and in the test-situation. Thus no clear meaning can be attached to the phrase " innate capacity." Is " innate " to be interpreted in a strictly genetical sense? If so there are appropriate methods, discussed elsewhere in this book, for investigating the extent of such differences in the test-behaviour of different individuals as are due to genetic differences between them. Unless we apply these methods we are not entitled to attribute the observed differences between individuals to differences in their " innate " or genetic constitution. Or does " innate " mean stable, as contrasted with unstable behaviour, or refer only to some trait characteristic of one individual and not of another? In either case it tells us nothing that we did not know before.

3. STRUCTURALIST VIEWS

Nowadays psychologists profess not to believe in "faculties" of the mind, such as memory, intellect, imagination, and so forth. Attempts to discover the structure of intelligence are now almost entirely framed in mathematical language. That is to say, the evidence for the existence of a number of different elements in what we call intelligent behaviour is obtained by comparing the performance of individuals on tests relating to different kinds of intellectual operations. If individuals made the same score on each and every kind of mental test administered to them we might be tempted to infer that all tests sampled a single and constant ability of the mind. If, on the contrary, there was no connection between the performances of an individual on different tests, we should be forced to conclude that abilities were all different and specific, and that there was nothing in human behaviour to which we could give the class-name of intelligence.

Statistical search for regularities in test behaviour is beset with difficulties. What the world calls intelligence varies enormously from time to time and from place to place. In a social environment that is constantly changing, human nature has shown itself to be remarkably plastic. *Prima facie* the task of establishing constant interrelationships between performances on different tests, when these tests select only a few of the enormous number of activities which human beings can potentially perform, is one of incredible complexity. Nobody can estimate with precision the sum total of gestural and linguistic

patterns that human beings can display. We have no inkling whatsoever of the limits within which ideas, moral beliefs, social constructs, and material artifacts may vary. It is not likely that a few thousand test data will tell us much that is significant concerning the structure and behaviour of man's central nervous system. An analogy may help to make this clear. Sir Richard Paget has recently estimated that upwards of 400,000 gestures with the striped musculature of the arms, hands, and face are possible. Is it likely that mathematical analysis, however elaborate, applied to data provided by testing the few stylized gestures exhibited in Anglo-Saxon society would throw any light upon the basic neuro-muscular patterns in human behaviour? When psychologists have a thousand mental tests, applied to several millions of individuals, they may perhaps be entitled to speak of having something useful to say concerning the structure of the mind.

The first and still most widely held version of what we may call mathematical mentalism is the Two Factors Theory of Charles Spearman. Spearman was already working with tests of intelligence before Binet had published his first scale. But his aims had little in common with those of Binet. He was indifferent to the possibility of applying our knowledge of the intellect to the solution of practical problems like that of mental defect. He was not interested in displaying the social distribution of mental abilities. Using specially constructed tests and ingenious statistical devices, he and his school have attempted to discover the nature of intelligence itself and its relations to other types of the mind's activity.

When the Binet test requires a child of three to oint to his nose if asked to do so, a child of five to pen the door, or a child of twelve to say what a icture " means," no assumption is made that these :tions proceed from separate and specific abilities of ıe mind. They appear in the test because each is an ĸample of a *class* of accomplishment normally ossessed by children at a given age. They imply the ĸistence of a general fund of energy or capacity, sing with age, which could equally well be mani-:sted in any one of a number of acts of a similar ind. We select those which are most common in ıe everyday experience of children at different ages. 'here is no reason, except convenience, why we should ot set a great many other tasks for the child to per-ɔrm, provided they all belong to the same order of ifficulty and are equally common to the experience f all children. This is the concept of " general ıtelligence."

But the search for unique or unit traits in intelligent ehaviour, comparable with other known mental and odily attributes, still continues. Eye-colour is specific ı this sense, although it is not necessarily a " unit " ait for the geneticist. The time taken by an in-ividual to respond with a jerk of the knee to a smart ıp on the knee-cap is another example. So also is ıe discrimination of musical pitch. The number f nonsense syllables (*e.g.*, jeb, wok, zug) remembered ıries with different people and is fairly constant for ıch individual. Spearman and his co-workers have ndertaken to discover if there exist any similar nique abilities in intelligent behaviour when ıeasured by different tests.

Spearman claims to have detected more than one such element in mental test reactions. Here we are concerned only with what he calls the "general" factor in intelligence, or "g." Had this been named otherwise, it would not be so easy to confuse it with Binet's concept of "general intelligence." In fact the two notions are quite different. The existence of "g" is inferred from a statistical relationship asserted to exist between the scores people make on a number of different tests of mental abilities. The general factor is not observed in intelligence as such, nor even in any one test. Some traits can be detected by naked-eye observation, such as the presence of a cleft palate or a club foot. Others may be seen by using a single measurement—*e.g.*, stature. In the case of "g" the trait is inferred from the presence of a certain regular correspondence between a number of different measurements. According to Spearman this regularity can be explained only if we postulate the existence of a common, as well as some specific factors in the measurements compared.

Tests can be constructed in such a way as to be highly "saturated" with "g." What is the status of such tests, and how do they compare with others? There is a common impression, not fostered by Spearman himself, that ratings assessed on "g-saturated" tests are superior to others in the field of mental measurement, since ordinary scales measure a number of discrete abilities associated in unknown proportions with the "general" factor. This impression is quite mistaken. The *reliability* of any measuring instrument can be gauged only by finding out if it always yields the same result when applied to one individual, if

we have no reason to believe that the individual has changed in the interval between taking the successive readings. The great majority of intelligence tests have a very high reliability in this sense, and may thus be presumed to measure a stable component of human behaviour.

If "g" tests are superior to others, therefore, it must be because what they test is more important than what is tested by other published scales. When the issue is put like this, unanimity is not to be expected. If Spearman's statistical procedure is correct, "g" certainly represents a less complex entity than "general intelligence," and might afford valuable assistance to genetic psychology. But it can never be a substitute for the *social* concept of general intelligence.

The psychological equivalent of the statistical "g," according to Spearman's well-known view, is the power to educe *relations* and *correlates*. The eduction of relations is easy to understand. If we are aware of any two things, we tend also to be aware of one at least of the relations that hold between them, even if it is only that the two things are different. Similarly, if we are aware both of a thing and a relation of a certain kind, we tend also to be aware of another thing which is in this particular relation to the first. For example, strike two notes, C and G, in succession on the piano. They constitute the musical relation known as the perfect fifth. Now strike a new note, D. If you are musical, you will see that the relation of the perfect fifth can be satisfied by striking A. A is therefore the correlate. Or again, look at the following series of numbers :—

1 2 4 7 11 16 22 . . . . . .

If I then ask you to put a number after 22, you will at once put 29. This number alone continues the relation between each successive pair in the preceding series—*i.e.*, that increases take place by one more each time.

Intellectually these abilities are of the highest significance. But they do not comprise the whole of the psychological situation involved in learning and applying what we have learned. They isolate one part only of the process in which the various stimuli to which we are exposed in our lives as social beings produce in us responses of different kinds. In the life of " pure " knowledge, or in a state of contemplation, or in the solution of jigsaw or crossword puzzles, they are of paramount importance. They form an essential part of our logical equipment. In the pursuit of the natural sciences, in economic, technical, political, and family activities, they require to be supplemented by other intellectual gifts. Traditionally logic and moral philosophy were the aristocrats of human knowledge. To-day we accord this distinction to the experimental sciences. To hold that intelligent behaviour consists exclusively of " pure " reasoning is like saying that beauty lies solely in the possession of a straight nose. Such aristocratic views may fit in well enough with one traditional element in our culture. They do not harmonize with the increasingly democratic structure of Anglo-Saxon communities.

Spearman's is not the only " factor " theory. In the last three or four years Thurstone and Hotelling have independently arrived at an alternative solution which is known as the Theory of Multiple Factors.

Considerable ingenuity has been expended in applying this method to the analysis of test scores, but as yet no results of any general interest have been achieved. It is quite conceivable that other mathematical methods of handling test data will be devised, all presenting a totally different appearance and all suggesting what we already know—namely, that there are common and specific elements in many mental tests, which we can evaluate for each test. There is no immediate likelihood, however, that any one method of treating the data will yield results of general application free from statistical ambiguity, or which can be readily linked with what we already know and do not as yet know about the neural basis of behaviour.

4. THE SOCIOLOGICAL VIEW

Even if we fail in our attempts to discover the inner structure of intelligent behaviour, we can always gain further knowledge of it by specifying in what social contexts it occurs, by whom it is manifested in various degrees, and with what other social attributes it is joined. This approach takes it for granted that what we put into a " battery " of tests stands in a definite relation to certain social requirements in the domain of individual behaviour. It does not imply that these tests enable us to isolate the different elements of which test-intelligence is presumably composed. It throws no light upon the mechanism or structure of the mind, or the ways in which the central nervous system works.

In Chapter III we have briefly described the contents of verbal tests of general intelligence. We have now

to ask how they are related to the times we live in. Individual tests, which still follow closely the Binet tradition, measure what growing children can normally be expected to perform in contemporary Western communities. In Group tests the problems set are somewhat more abstract and artificial. They are almost entirely tests of verbal logical ability—*i.e.*, ability to manipulate given sense data in ways useful for the classification of objects in the external world. Such ability plays an indispensable part in intellectual activity. It is manifestly not the only trait which decides whether or not an individual is to be intellectually efficient in the long run.

Logical abilities of this kind grow very quickly during the stage of physical maturation. In the ordinary child they are practically complete by the time of adolescence. Their existence can be detected by very simple means. Children need to have them if they are to learn the things they are expected to learn in modern industrial communities. Our educational system aims to train a large number of children to do things for which there is a great demand in the economic, social, and cultural life of our times. The tasks set in twentieth-century schools are different from those likely to be required under totally different historical and economic circumstances. They would not be of much use to children in South-Eastern Europe or in Abyssinia, where the pattern of life is still largely rural. They would not have been relevant to a militarist society like Sparta. Anthropologists have shown us that surviving primitive peoples think and argue in ways which we should consider " illogical."

Therefore, when we are looking for a definition of

test-intelligence, the essential thing to notice is that it refers to the ability of growing children to make progress in the tasks set them at school, many of which resemble in miniature the situations occurring in adult life as it is lived to-day. The existing educational system aims at training those abilities useful in a trading community, in which commerce, administration, and teaching employ large numbers of our most literate citizens. It is not an accident that the children of civil servants, clerks, and teachers rank amongst the highest in test-intelligence. We have naturally and inevitably, but quite unconsciously, adjusted what we put into intelligence tests to produce this result. If, as some believe, the further development of capitalism will lead to an even greater emphasis on selling goods, as contrasted with making them, the intelligence tests of the future may grow to resemble tests of salesmanship.

At present, however, they continue to represent mainly the requirements of partially socialized occupations in Anglo-Saxon countries, and especially those of public administration. Fortunately the academic tradition is still strong enough to prevent them degenerating into tests of skill in selling parlour-games or propaganda. If in what follows I call attention to the limitations of academic concepts of test-intelligence it is not because I do not recognize how great a part logical analysis plays in intellectual labour and social life. What is not so generally recognized is that other qualities besides intellectual capacity, as measured in the test-situation, enter into the discovery of new knowledge and help to enhance man's control over the external world.

Intelligence tests do not pretend to measure what Thorndike calls "social intelligence," the ability to get on with other people in a co-operative society. No test-situation corresponds to the construction of a scientific hypothesis or of a work of art. The ability to discover or to make new things, or to illumine the world of the imagination, is not measured by existing tests.

5. LIMITATIONS OF TEST-INTELLIGENCE

The academic tradition represented in nearly all published tests fails to recognize the importance in a definition of intelligent behaviour of abilities not strictly logical in the conventional sense of the word. Until very recently educational psychology has exalted the claims of "reasoning" to the exclusion of other elements in the process of learning and doing. Reasoning was defined as thinking logically. But the meaning of logical thinking is not self-evident. Psychologists took over a kind of logic that is as old as Aristotle, that was universal during the Middle Ages, and that seemed to triumph in the concepts of Newtonian mechanics. It was almost entirely deductive. The social content of deductive logic is authoritarian. It was very useful in an age when the only recognized intellectual workers were theologians, moralists, and lawyers, concerned to maintain intact certain fundamental axioms or dogmas.

Our educational system was and remains enormously influenced by the humanist tradition of the classical renaissance and by preoccupation with the art of politics. The curriculum of our schools has always been overloaded with the study of dead languages.

Proficiency in these requires obedience to certain rules fixed in the remote past and the ability to understand a finished system of linguistic usages. The study of Latin and Greek does not help people to recognize what is to be done in a world that is constantly changing. Spearman has shown that "g" is present in the ability to succeed in Latin to a greater extent than in any other school subject. The significance of this fact has not hitherto been appreciated. It illustrates both the essential nature and the limitations of "g." Great intellectual ability is required for success in learning Latin, but it is the ability to understand and operate a fixed and authoritarian system of concepts. "g" does not provide a recipe for intellectual *discovery*.

When those whom the poet has called the "makers" act and think, they employ deductive logic over only a part of the process. In creative labour of the kind that consists in changing the world a zest for observation, a practical desire to make new things, a bold but controlled imagination, the gift or habit of "tough-mindedness," and the necessary temperament to persist in the teeth of technical difficulties and social discouragement are more decisive in the successful accomplishment of tasks than any single ability like logical reasoning. Faraday and Pasteur were not stupid men, but the historian of their lives emphasizes more their toughness of character than their sheer intellectual ability. Similarly the experience of adjusting oneself to the opportunities and responsibilities of a free citizen in a democratic community calls for new qualities to supplement those that make only for obedience.

Before we attempt a summary definition of what it is that intelligence tests measure several other considerations deserve brief mention. Existing tests relate to the performance of children, not adults. It is astonishing how often this point is overlooked. If we apply them to adults, we do not obtain results which entitle us to compare one adult with another except with respect to what they do on tests designed for children. Nobody has ever proved that the comparative ranking of adults on such tests corresponds significantly with independent estimates of adult intelligence. In practice it is almost impossible to obtain general estimates of this kind. The reason is plain. The majority of adults do not share the compact and homogeneous environment that distinguishes children at school. The post-school development of an individual's behaviour does not resemble its growth between birth and puberty. We cannot any longer decide how intelligent a person is without taking into account the specific character of the work he has to do. There are innumerable occupations differing in their technique, training, and the requirements they make for intellectual and temperamental qualities. Some people enter jobs for which even the slender educational training of the elementary school is more than sufficient for the due performance of their work. By contrast others specialize in abstract intellectual operations like mathematics. As a rule the gap between intellectual potentiality and intellectual output becomes wider with increasing age.

Even among children performance on intelligence tests does not correlate perfectly with school achievement. Among adults the contribution of factors

other than those measured by existing tests is of vastly greater importance. They differ strikingly in opportunities of learning. Temperamental differences have freer play than they have in the school. In a real sense the environment of the school is an artificial one like that of the laboratory. Children lead comparatively simple lives and have to perform comparatively simple tasks. The disciplined routine of school makes it easy to control differences due to temperament. It is thus possible to isolate and to measure the more purely intellectual activities which are growing at this time. For these reasons it would be absurd to hold that test-intelligence as we know it is co-extensive with human intelligence over the entire life-span of individuals. No doubt many important intellectual powers are mature at early adolescence. This does not entitle us to say that the differences individuals show before this age will correspond at all closely to subsequent differences in their intellectual output and efficiency. Attempts have been made by vocational guidance workers to rank different occupations according to the different levels of general intelligence they require. This is a difficult but useful task. But it is easy to over-estimate the prognostic value of test-intelligence for the purpose of placing young persons in the jobs that will suit them best.

Still more serious would be the error of supposing that the distribution of adult ability corresponds at all closely with the existing distribution of jobs requiring varying amounts of general intelligence. Such evidence as we have relating to the after-careers of young persons educated in London elementary schools indicates that the possession of high or low intelligence

is of little account in deciding the nature of the occupation followed. The chief effect of the secondary school scholarship system is to improve the selection of children as clerks and teachers. It is highly significant to the understanding of what intelligence tests measure that they are most reliable in prognosticating success or failure in clerical occupations.

We can understand the significance of those powers which grow between birth and puberty, and which are tested in children, only if we interpret them as setting limits, upper and lower, to the manifestation of intelligent social behaviour. In other words, a child with a very high test-intelligence *may* be able to show high intellectual efficiency in after life. A child who does badly on tests will probably never achieve so much. Limits of a different kind are imposed by temperamental factors. Whether an able child fulfils his early promise or not depends on his total personality and on the opportunities which society allows him. It is well to remind ourselves also that our existing methods of teaching backward and bright children and children of different temperaments help to determine the intellectual efficiency of the population. Modern methods of teaching the calculus enable it to be learned by boys and girls in secondary schools, although only a generation ago it was thought too difficult for any but candidates for university honours in mathematics. This does not mean that teachers who teach the calculus to-day are of higher test-intelligence than those of thirty years ago, nor that the children who learn it are brighter than their fathers were. What has really happened is that numbers of patient and moderately intelligent

expositors have gradually found better means of making the calculus understood. There is no reason why similar improvements might not considerably raise the achievement of individuals now regarded as intellectually backward. The more we know about the interests of children and the more interesting we can make the things we teach them, the greater will be the return for our educational efforts.

6. GOOD INTELLECTUAL HABITS

It is possible to neglect, through an obsession with tests designed to elicit general intellectual ability, the corresponding advantages of good intellectual *habits*. Highly intelligent people may not fall victims to fallacious beliefs so often as persons of low intelligence. There is plenty of historical evidence that they do so sometimes. Pure intelligence, if such a thing exists, is something which may occupy itself with chess as well as with useful things. It falls easily into the errors of irrelevance and scholasticism. It may be concerned as much with socially dangerous as with socially beneficial objects. The test-intelligence of Leopold and Loeb, the Chicago millionaire murderers, was among the highest ever recorded in the U.S.A. A good intelligence, then, requires to be supplemented by good intellectual habits. People must be taught to apply their minds to the mastery of urgent and vital issues and to tasks likely to benefit the community from which they derive their sustenance.

It would not matter from the standpoint of civilized progress if a community depended rather more on good intellectual habits and rather less on superior test-intelligence. Our educational system exists partly to

equip people with good intellectual habits. There is every reason to believe that improvements in this respect would contribute just as much to the intellectual efficiency of the nation as a policy of selecting for further and higher education only those who excel in test-intelligence. The fact that improvements of this kind have no upper limit conceivable to-day is sufficient by itself to refute alarmist views about the impending intellectual decline of England. If our civilization is in danger, it is partly because many highly intelligent persons have not learned the necessity of good intellectual habits or have inherited a social tradition which precludes them from acquiring them. It would be heresy, in spite of apparent dictionary justification, to indict the intelligence of our militarists. The peril that threatens from these and other groups of people with supposedly high intelligence is incomparably more real and urgent than any that arises from the presence of a few hundred thousand mentally inferior individuals.

7. SUMMARY

Verbal tests of general intelligence measure the ability of growing children to perform certain tasks conventionally designated by the adjective "intelligent." These tasks are selected because they enable us to compare the *educability*, with existing methods of teaching, of children attending schools for the most part maintained by the State, whose main social function is to supply recruits for the rank-and-file of commercial, administrative, and professional occupations. Such tests do not tell us anything specially

important about what we mean by intelligent behaviour in *adults*, nor do they enable us in general to predict the character of an individual's intellectual *achievement*. For the great majority of individuals test-intelligence imposes an upper and a lower limit to intellectual usefulness.

The task of social psychology is that of stating *all* the relevant limiting factors to the social usefulness of individuals. The discovery of one series of limits may have led some to acquire a disordered perspective and to make exaggerated claims for the results of intelligence testing. Even so, this was probably a necessary step to a more complete prognosis. The errors of enthusiasts ought not to drive us to the opposite extreme, and make us neglect the importance of intelligence testing in any survey of the human resources available to a planned society.

CHAPTER VII

ABILITY AND OPPORTUNITY

1. THE NEED FOR A CENSUS OF INTELLIGENCE

IN recent years there has been a growing recognition of the value of regular and comprehensive surveys of the nation's resources, both in material wealth and in personnel. Over an increasing area of the domain of legislation the rule of untutored intuition and bluff prejudice, which constituted for our ancestors the "art of politics," is giving way to an attitude that has its origin in the scientific movement of modern times. To-day it is customary for governmental action to be preceded by the systematic ascertainment of the exact nature of the problems to be solved. We do not now embark upon a rebuilding programme without first discovering the facts relating to the nation's housing. From time to time the State authorizes a geological survey of the mineral resources of the British Isles. Every ten years the Census of Population enumerates the people, and describes their sex, age, occupation, marital condition, and so on. The Census of Production gives a periodic account of some of the changes that take place in the economic structure of the community. Estimates have even been made by Royal Commissions of the number and local distribution of mentally defective individuals. But no public

authority has yet attempted any national survey of the distribution of normal intelligence or of high ability upon the use of which, to a considerable extent, the efficiency of our national life depends. It is the sign of a pre-scientific attitude to politics if a matter becomes one of social concern only when things go wrong. The *laisser-faire* policy of past generations discouraged the deliberate organization of plenty, but it could not stop State intervention to prevent things getting worse. There is now a growing belief that we must plan how things which are not actually deteriorating can be made still better.

Much social psychology is concerned with issues that are felt to have no urgency. It may be that the reluctance of the public to finance sociological studies arises from their past failure to discover plain facts which interest the plain man. Facts of this kind include the human resources available to assist in the task of civilization and the extent to which man-made social arrangements promote or retard this process. Those in this chapter were gathered in a survey of the test-intelligence of a large sample of London school-children, undertaken by the Department of Social Biology in the University of London, and conducted by the present author and Miss Pearl Moshinsky.[1] It enables us to answer two questions: (1) How is intelligence distributed between different sections of the community? and (2) How far does the community, as at present organized, utilize the high ability that exists in different social strata?

The object of this chapter is to display the distribution

[1] For a fuller account, see *Sociological Review* for April and July, 1935.

of *test-intelligence* within a population of varied social composition and to compare it with the distribution of *educational opportunities* among children of different social origin. To what extent does the existing machinery of social selection adjust educational opportunity to individual ability? Conversely, how far do facilities for higher education go with social status rather than ability? The nation which has achieved, or is in rapid process of achieving, a close correspondence between the social distribution of ability and the social distribution of opportunity may not necessarily claim the title of a democratic society. Still, it is at least one in which high ability is not wantonly wasted nor privileges assigned without regard to merit.

The following discussion is limited to the opportunity of higher education at the school stage. In the near future we may look forward to studies which include the entire range of educational facilities, reaching to technical institutions and universities, and to others concerned with *occupational* opportunity. The preliminary studies of Professor Ginsberg and others confirm the view that entrance to certain professions and business careers is determined to a very large extent by educational and economic advantages which are distributed very unequally throughout the mass of the nation. There is a vital need for this issue to be examined in a comprehensive and objective way.

Before 1934 no attempt had been made to compare the intelligence of adequate samples of English children educated in schools of widely varying educational and social type. The recent nation-wide inquiry into *The Intelligence of Scottish Children* (1933) of a single age-

group included private as well as elementary pupils, but the data have not been separately analysed. In countries like the U.S.A. or Scotland, where the vast majority of children, except the richest, are educated in State schools of uniform type, the problem appears to have less urgency. In England, however, there are two main sources of inequality in educational facilities. (1) Of school-children under the age of fourteen about 11 per cent. receive an education the cost of which is defrayed either wholly or in great part by their parents. Of children over fourteen the proportion is even higher. (2) In the elementary school population children are selected for further education of a higher type—*i.e.*, in secondary and central and junior technical schools—at the age of eleven plus. This selection is determined both on scholastic ability and on the number of free places available, and thus the examination is a competitive one. For the country as a whole about 7 per cent. of elementary pupils proceed to secondary schools with free places and another 4 per cent. as ordinary fee-payers. A larger proportion continue their education in central or junior technical schools, which are increasingly designed to provide a planned curriculum of a more elaborate type than is provided in the junior school. No reliable figures exist for the country as a whole, but in London just over 12 per cent. are drafted to central schools. The rest—some 77 per cent. of the whole—remain in the ordinary elementary school, leaving to earn their living at the age of fourteen plus.

During the year 1933–34 over 10,000 school-children between the ages of nine and twelve and a half years, drawn at random from elementary, central,

secondary, private, and preparatory schools in the London area, were tested with the Otis Group Advanced Intelligence Test, adapted for English children. The sample furnished a cross-section of every type of school in the Greater London area, which has a population of over ten millions. The great "public" schools were not visited, since in their case the age of entry is generally thirteen, but the preparatory schools examined included children who would eventually proceed to public schools.

2. THE INTELLIGENCE OF LONDON CHILDREN

The following table shows the average intelligence, expressed in terms of Index of Brightness (since I.Q. is unreliable for older and superior children),

TABLE II

MEAN I.B. OF DIFFERENT SCHOOL POPULATIONS

Type of School.	I.B.	N.
Elementary, aged 9.0–11.0	97·2 ± 0·58 [1]	2,261
Elementary, aged 11.1—12.6	93·2 ± 0·78	1,457
Central	126·8 ± 0·40	2,026
Secondary Free Pupils .	147·3 ± 0·57	1,038
All Free Pupils . .	98·4 ± 0·43	6,782
Private	108·4 ± 1·11	728
Preparatory . . .	126·9 ± 0·96	988
Private and Preparatory .	119·0 ± 0·76	1,717
Secondary Fee-payers .	118·8 ± 0·66	1,661
All Fee-paying Pupils .	118·9 ± 0·57	3,378
Mean of All . . .	100·1 ± 0·40	10,160

[1] In this and subsequent tables these figures refer to the standard error of the mean.

of pupils in the various schools examined. The children have also been classified according as they are free or fee-paying pupils. In calculating these last figures a system of "weighting" was adopted, to take account of inequalities in sampling and of the relative contribution of various types of school to the total school population.

The first impression gained from these figures is that children who belong to the class whose parents can afford to pay for their education are considerably more intelligent *on the average* than those educated at the expense of the State. (The exceptionally high average I.B. of secondary free pupils arises from the fact that they are selected for high intelligence, and is therefore irrelevant to this issue.) But it would be highly misleading to restrict the comparison of the intellectual composition of these two groups to a comparison of their *average* intelligence. By themselves averages cannot tell us the *proportion* of individuals of high or of low ability in the groups to which they refer. The fear of racial degeneration is widespread in England. It would not be unfair to say that it arises mainly through the enormous current under-valuation of the intelligence of the poorer classes, which in turn is based on a popular fallacy. An average figure does not correctly describe *all* the members of a group to which it refers. If we stop to think, we recognize that the group may contain many persons *below* and many persons *above* the average. Recently a number of medical authorities responsible to the Ministry of Health reported that on the average the income of the unemployed was sufficient to enable them to obtain a diet of the proportions necessary for health and efficiency. At the

time few saw that this statement was itself evidence of the existence of a large amount of destitution. Social policy cannot be based exclusively on a knowledge of averages. In this case the important thing was to discover if there were any significant number of persons in need of further assistance from the State. Interpreted in a slipshod way, the average encourages a complacency unwarranted by the figures themselves.

TABLE III

PERCENTAGE DISTRIBUTION OF I.B. IN VARIOUS SCHOOL POPULATIONS

I.B.	All Free Pupils.	All Fee-paying Pupils.	All Pupils with opportunities of higher education.	All Pupils.
200–9	—	0·1	—	—
190–9	0·1	0·4	0·6	0·1
180–9	0·2	1·5	1·9	0·3
170–9	0·3	2·5	4·2	0·5
160–9	1·2	4·2	7·8	1·4
150–9	2·4	6·8	12·1	2·7
140–9	4·2	9·9	14·2	4·6
130–9	6·4	11·1	13·0	6·7
120–9	8·9	13·0	11·6	9·2
110–19	11·2	13·3	10·0	11·4
100–9	12·4	12·1	8·4	12·4
90–9	11·8	8·9	5·8	11·6
80–9	13·0	6·4	4·1	12·5
70–9	11·0	4·5	2·9	10·5
60–9	7·9	2·7	1·7	7·5
50–9	5·6	1·4	0·9	5·3
40–9	2·1	0·9	0·6	2·0
30–9	0·9	0·3	0·2	0·9
20–9	0·3	0·1	—	0·3
10–19	0·1	—	—	0·1

Thus what we require is a picture of the total distribution of intelligence within contrasted groups. Table III, p. 90, gives the percentage of free and fee-paying pupils at various levels of I.B. It includes also similar data for that section of the school population which, whatever its origin, enjoys the opportunity of secondary education.

The next stage is to show what proportion of children of different social and educational status attain or exceed a level of intelligence which can be reasonably held to indicate high ability as measured by intelligence tests. For this purpose we have chosen that level reached by roughly 50 per cent. of all fee-

TABLE IV

PERCENTAGE OF PUPILS IN VARIOUS SCHOOL POPULATIONS AGED 9.0–12.6 WITH HIGH ABILITY

	I.B. 120 and over.
1. Elementary, aged 9.0–11.0	21.2
2. Elementary, aged 11.1–12.6	17·6
3. Central Schools	65·5
4. Secondary Free Pupils	93·3
5. Secondary Fee-payers	48·7
6. Private Schools	35·5
7. Preparatory Schools	60·1
8. Private and Preparatory Schools (combined)	49·5
9. All Free Pupils	23·7
10. All Fee-paying Pupils	49·6
11. All with Opportunities of Higher Education.	65·4
12. All	25·5

paying pupils. All such levels are, of course, in one sense arbitrary; but this one has at least the merit of plausibility, since hardly anyone will deny that the top 50 per cent. of children in fee-paying schools deserve educational encouragement.

3. WHERE OUR ABLE CHILDREN COME FROM

We now know the *proportions* of able individuals in our present sense of the term that are found amongst various categories of school-children. But proportions, like averages, have their limitations. We cannot answer the questions raised at the outset unless we recognize that the populations represented by these various groups are vastly unequal in *size*. In our age-group there are nine times as many free pupils as fee-paying pupils. Now, if you have two populations, one of ninety and other of ten, the former containing 30 per cent. of able individuals and the latter 60 per cent., the actual *numbers* of able individuals in each will be thirty and six respectively. While the proportion in the latter is twice as great, its numerical contribution to the total number with high ability, when both populations are taken together, is only six out of thirty-six, or 17 per cent. The former group, containing a smaller proportion of able individuals, contributes 83 per cent. of their total number.

With this in mind we next have to ask what is the relative numerical contribution to the total number of able individuals in the school population made by pupils from different types of schools. The figures, given in percentages, are as follows:—

TABLE V

CONTRIBUTIONS OF DIFFERENT SCHOOLS TO TOTAL SCHOOL POPULATION WITH HIGH ABILITY

(I.B. 120 and over; age-group 9.0–12.6 years.)

School.	Percentage.
Elementary, aged 9.0–11.0	42·0
Elementary, aged 11.1–12.6	23·4
Central	12·7
Secondary Free Pupils	5·8
Secondary Fee-payers	4·8
Private and Preparatory	11·3
	100·0
All Free Pupils	83·9
All Fee-payers	16·1
	100·0
All in Elementary (including Central) Schools	78·1
All in Secondary, Private, and Preparatory Schools.	21·9
	100·0
All Pupils *with* opportunities of Higher Education	42·9
All Pupils *without* opportunities of Higher Education	57·1
	100·0
Able Free Pupils: Proportion with opportunities of Higher Education	36·0
Fee-Paying Pupils: Proportion with opportunities of Higher Education but without high ability	50·5

These figures are very striking. When it is shown further that only a little more than a third (36 per cent.) of able children in elementary schools receive

free places in secondary schools, we are driven to conclude that the community has still a very long way to go before it can be said to make adequate use of the high intelligence to be found in the mass of the population. No view of the impending intellectual decline of England is worth the trouble of putting on to paper which neglects these vast unutilized reserves of high ability. The argument from the discrepancy between the average ability of gifted children in different social strata is seen to lose much of its practical significance. It is overwhelmed by the enormously greater actual numbers of superior children who originate in elementary schools. In one of the finest poems written in our age, G. K. Chesterton describes the masses of England as the "Secret People." One thing they have succeeded in keeping secret is the extent of their high ability.

I do not deny that the inferiority of the mean intelligence of children from relatively poor families creates a problem that urgently calls for investigation. Indeed, in a later chapter an attempt will be made to review the issue. But in the present context the relevant fact is that on their observed performances alone the comparatively poor very greatly preponderate in the production of individuals of high ability. That being so, it follows that an educational policy concerned with the training of a sufficient number of children to supply the social demand for highly educated persons ought mainly to be directed to the provision of improved facilities for the further education of children of elementary school origin. It is startling to discover, for example, that in London there are actually more able children in central schools

than in all fee-paying schools put together. Yet practically none of these have the opportunity of entry into the professions and the higher ranks of the business world enjoyed by those who attend secondary or public schools.

Few children whose parents are able and willing to pay fees for their schooling are deprived of the prospect of receiving a higher school education. This applies equally to children whose intelligence falls short of the level selected here. Even in the absence of a brilliant scholastic record, attendance at a public school confers unfading laurels on those fortunate enough in after-life to sport the old school tie. The prestige attached to secondary schools is less, but it is sufficient to create advantages in the search for employment that are not possessed by the child who finishes his education at the elementary school. It is almost impossible for a less gifted child of the working classes to scrape into the ranks of the highly educated. The severity of the scholarship examination which selects "free placers" in secondary schools allows only about 5 per 1000 of the duller children to proceed thereto. On the other hand, by our definition of high ability, one-half of all fee-paying pupils fail to reach it.

4. SOCIAL INEQUALITY IN EDUCATION

Calculations based on these discrepancies yield two astonishing results. One is that when we compare children of equally high ability, seven fee-paying pupils will receive a higher education for every one free pupil. The other is that a child of inferior ability born with a silver spoon in his mouth has more

than a hundred times the chances of receiving a higher education than a correspondingly dull child of the masses! Here are objective indices of social inequality based on psychological experiment and official statistics to combat the complacency of those who pretend that the educational ladder is already too congested. If it is congested, the reason is that there are insufficient places for elementary children with high ability, and that many of the available places are occupied by inferior children whose parents can purchase for them the privilege of a higher education irrespective of comparative merit.

These facts should be of interest to students of other aspects of social organization. A minimum standard of educational equipment is an indispensable condition of entry into a large number of occupations. Lack of opportunities for higher education, imposed upon children of the poorer classes by the inadequacy of existing facilities, therefore constitutes a serious impediment to free movement in the labour market and is an important source of class stratification. When economists, for example, speak of "economic freedom," are they aware of the implications of this fact? The major part of the inequality remains after account has been taken of the relative ability of each social class. We are therefore confronted with disparities due to differences in social institutions, not to hereditary inequalities between human beings. Even so, the figures probably minimize the contribution of institutional agencies to differences in opportunity, since the inferior average ability of the lower social classes may itself arise partly from their environmental disadvantages.

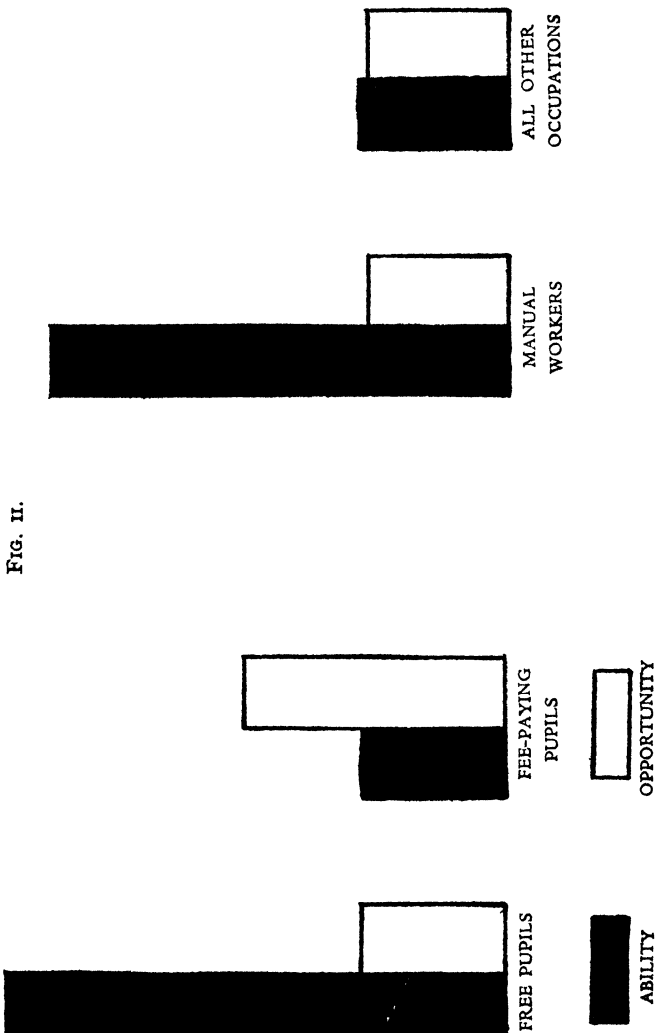
FREE PUPILS
FEE-PAYING PUPILS
MANUAL WORKERS
ALL OTHER OCCUPATIONS
ABILITY
OPPORTUNITY

FIG. II.

The figure on p. 97 shows the ratio of the total with high ability to the total who have opportunities for higher education in the two groups of (1) free and fee-paying pupils respectively; and (2) manual workers and all other occupational categories put together.

It will be observed that the argument has so far employed a very high criterion of intelligence. The reader will remember that the figure selected was such that roughly 50 per cent. of all children in fee-paying schools exceeded it, contrasted with about 25 per cent. of free pupils. We have no reason to believe that this level represents the psychological limit below which children are incapable of benefiting from higher education. It may be doubted if any educationist, still less a fond and affluent parent, would agree that nearly 50 per cent. of middle-class children derive no benefit from education beyond the age of fourteen. The wisdom of encouraging the higher education of those who possess exceptional intelligence is undisputed. It does not follow that we are justified in excluding all of a lower standard of ability. Few, except the very dullest, fail to benefit in some degree from the experience of an advanced education. Indeed, we are practically unanimous that the goal of a civilized nation is to raise, without any apparent limit, the cultural level of all its citizens.

Let us therefore take a somewhat less rigorous definition of high ability—*e.g.*, the level reached by all but 10 per cent. of children in fee-paying schools. Over 70 per cent. of elementary school children attain the same level, and would thus be equally eligible to benefit from a higher education. But still only 7 per cent. eventually obtain scholarships

to secondary schools, and less than 4 per cent. proceed there as fee-payers. The discrepancy, as we should expect, is even more remarkable. However we look at it, social inequality in the distribution of educational opportunities exists on a scale exceeding the wildest guesses of irresponsible agitators. The argument is in fact independent of the level of intelligence we care to choose, and involves no assumptions concerning educability or capacity to benefit from advanced education. Had our object been to find an agreed standard of fitness acceptable to students of different social opinions and applicable to children of different social origins, this investigation could never have been undertaken. The I.B. levels selected were employed solely to designate proportions of contrasted social groups distinguished by the possession of different degrees of educational opportunity.

5. THE SOCIAL ORIGINS OF THE ÉLITE

To those who have taken the trouble to acquaint themselves with every-day life these conclusions may not be entirely unexpected. Others, while compelled to admit them, may take refuge in the retort that the facts as stated throw no light on the social origin of the really exceptional individuals, the *élite* of modern society to whom some psychologists boldly ascribe "genius." There is a common impression that these are rarely found in the elementary schools and are for the most part children of the higher social and professional classes. This may be true of the Land of Promise, and indeed Terman's work may seem to have shown it to be true in California. As a statement about England it is a myth. If we

take Professor Cyril Burt's criterion of exceptional talent—namely, the intellectual level of the uppermost one per thousand of the general school population—then more than two-thirds originate in the elementary school, of whom no less than 70 per cent. consist of children of wage-earning parentage. All told, the wage-earners supply 50 per cent. and the higher social and professional classes 33 per cent. of our English "geniuses." On the other hand, if the criterion were pushed up so that we selected only the top dozen or so of all school children (which we have as yet no statistical right to do), we might well find that the great majority came from the middle and upper classes.

At this point we may pause to consider a possible criticism. How far can we trust the Otis Test used in this investigation? The Test is indeed highy reliable, in the sense that whatever it does measure it measures accurately. But what does it measure? The Otis Test, like most Group tests, is highly charged with verbal and educational material—to a larger extent, perhaps, than tests selected on the basis of "saturation" with Spearman's "g." This being so, the kind of test-intelligence it measures has some relation to *educability*, or at least to educational experience. It ought not to be regarded as entirely free from environmental influences and merely as a test of "innate" intelligence (whatever that may be). We may therefore interpret the results of this investigation as indicating: (*a*) the superior *average* educability of fee-paying pupils; and (*b*) the *numerical* superiority of highly educable free pupils. The education enjoyed by elementary school pupils between

the ages of nine and twelve and a half years may be more efficient than that provided in fee-paying schools. The cultural background of free pupils may be superior, and thus increase their verbal ability. On the other hand, the reverse may be true. So we cannot safely say that what we are measuring is a genetic difference between two contrasted social strata. If the home and school background of the relatively poor is inferior to that of the relatively prosperous it is likely that an improvement of the environment of the former would raise their average Otis Test-intelligence, and thus actually magnify our estimate of the gap between ability and opportunity. To be sure, the use of different tests might produce somewhat different results. However, it is not likely that the *order of magnitude* of the differences observed would be materially altered.

6. REFORMING ENGLISH EDUCATION

When we consider this vast reservoir of unutilized talent, it is obvious that the task of providing a higher education for all of it is a very heavy one. The cost would raise the national bill for education to the level of our expenditure on armaments, and most people still prefer armaments to education. Moreover, the present structure of economic organization would not permit the absorption into remunerative positions of so vast an output of highly educated persons, as we now define them. We have not yet acquired in this country a tradition of genuine social democracy which in America enables people with a college education to be content with jobs which are here restricted to graduates of the elementary school.

We have no certainty that working-class boys with brains would be preferred to nit-wits who can sport the old school tie. Again, custom prescribes that highly educated young persons must step into well-paid jobs. If such jobs were not available, the probable consequence would be, as in Germany, Austria, and France, a deplorable increase in Fascist sentiment. Indeed, a great extension of educational facilities would be futile, if it resulted mainly in young persons wanting to become clerks and professors. Thus a new conception of educational humanism is required to meet the needs of an age in which an increasing proportion of the working population will be engaged in skilled but light mechanical employments, with ever-growing periods of leisure.

Whatever we do we must redress the social grievance that arises owing to the preferential encouragement of more prosperous children in the selection of individuals for higher education in schools within the ambit of State control. There are two possibilities open to us. In the first place, we could nationalize all schools that at present provide a higher education. This would involve the incorporation of the public schools and the grant-aided secondary schools into the framework of public education. We should then have at our disposal half a million school places, in addition to an unknown number of places in private schools. Opportunities of a higher education would then be distributed among children of different social origin strictly on a basis of ability. If this were done we should be educating roughly eight children of elementary school origin to one of private and preparatory school origin, instead of the present

proportion of approximately three to one the other way round. Terrific resistance would be offered to such a proposal, which would have the additional disadvantages of destroying the economic *raison d'être* of preparatory schools and costing a formidable sum of money. While no compensation need be paid in the assumption by the State of educational endowments, the annual cost of maintaining so great a number of free places would run into many millions of pounds.

But if we restrict our ambitions to the secondary schools the cost would not be so great, nor the inertia of vested interests so difficult to overcome. It is commonly believed that the function of the secondary school is to drain off the best talent of the elementary school. This is only partly true. About 54 per cent. of all secondary schools are maintained entirely by the local education authorities. The rest continue to be independently controlled by Boards of Governors, receiving grants from public funds in proportion to the number of free places they provide, most of which are occupied by scholarship children from elementary schools. The county secondary schools are not entirely free. They contain, on the average, almost as great a proportion of fee-paying as of free pupils, and the average fee therein is two-thirds as high as in the grant-aided secondary schools. Taking all secondary schools together, free and fee-paying pupils are found in equal numbers. Half the fee-payers, in addition to the great majority of the free pupils, are of elementary school origin.

This arrangement is admittedly defective. 48 per cent. of the fee-paying pupils fall below the standard obtained by 95 per cent. of the free pupils.

Their education costs the community a great deal of money. If we were to assume control of all the grant-aided schools, we should be able to effect a redistribution of school places that would give preference to abler children, irrespective of their social and economic status. In that case secondary schools would consist of eight free pupils to one fee-paying pupil, as compared with the present proportion of one to one.

But where, you may ask, is the money to come from? It will come from the great savings that will be effected by the continuous and progressive fall in the number of children of school age, which has already begun in consequence of the declining birth rate. It would not be true to say that the State will save the whole of the average *per capita* cost of the education of these unborn children. The resulting smaller size of classes, however, will increase the efficiency of education and the amenities of teaching. Nor can we ignore the movements of population that require new schools to be built in new residential areas. Much remains to be done to improve the general standard of school buildings and equipment. Nevertheless the number of children of higher education age will also ultimately decline. In perhaps ten years from now it will be possible to contemplate a radical reform in secondary school education on the lines I have suggested without involving any significant increase in public expenditure.

The habit of indulging in impassioned propaganda for a vaguely conceived millennium merely plays into the hands of conservatism. Without adequate and objective scientific investigations of the kind I have described here our agitators, no less than our legis-

lators, will be taken by surprise. If we are not watchful, the surplus released by the declining population of school age will be imperceptibily swallowed up, year by year, by the insatiable super-tax payer. Are these people to receive a windfall of such magnitude? Alternatively it may be frittered away in ill-considered and haphazard expenditure on rescue work on behalf of those who have been turned out of school at the age of fourteen. Nothing could be educationally more vicious than raising the school-leaving age to fifteen or sixteen without vast changes in the character of public education. If children were to stay on in obsolete elementary schools beyond the age of fourteen, they would acquire, and with reason, a hatred of the educational process that would poison our social policy for generations. More room must be found in a reorganized secondary school system for children of adolescent interests to whom the servitude of the elementary school is intolerable. It might be proposed at first, on the ground of economy, to exclude the existing inferior fee-paying pupils from secondary schools, and thus make room for more gifted free pupils. This would be an act of distributive justice. But a less vindictive policy would harmonize better with the spirit of an age of plenty. Whatever we decide to do, the problem is urgent. It will take ten years to carry out far-reaching changes of the kind I have proposed. Buildings must be increased in number, re-planned, and re-equipped; more highly trained teachers will have to be provided. If we are to obtain the full advantage from the windfall presented to us by the declining fertility of the population, we must act without delay.

CHAPTER VIII

NATURE AND NURTURE

IN no field of thought, unless it be economics, do bad intellectual habits cause so much confusion as in the popular discussion of heredity and environment in human affairs. To some it seems perfectly obvious that Miss Smith sings so nicely because she inherits the gift for music from her father, who is organist and choirmaster. Others are convinced that their sons can never become gentlemen unless they receive the benefits of the environment provided exclusively by the great public schools. In both cases it is just as easy to interpret the facts the other way round. Miss Smith may sing because her environment is a musical one. The sons of the rich may succeed because they are of a superior breed. What we believe depends very largely on what we wish to believe.

1. HUMAN SOCIETY NOT A STUD-FARM

Although they look simple enough at first sight, the problems of Miss Smith and the Etonian are actually very difficult, and call for trained and disciplined ways of thinking about them. After the general acceptance of the evolutionary hypothesis it became customary to argue that since man is an animal much of what he does must be the result of biological inheritance. However, nobody seriously believes that

civilization itself is inherited in this way, nor questions the need for education and training, laws and manners. Man is distinguished from other animals mainly by the greater plasticity of his behaviour in a social environment. The central nervous system with which he is endowed at birth is capable of acting in very different patterns in response to very different sets of external circumstances. In a civilized state he is influenced much more by his artifacts, material and social, than by physiographical conditions which he has done nothing to shape. It is here that the familiar comparison of the stud-farm breaks down. Race-horses are bred and reared in a highly simplified and standardized environment. They all receive much the same diet, medical care, and training for the track. Hence the differences they exhibit are to an overwhelming extent determined by their different ancestry. Even though he may be perpetuated only for the sport of gods, man is not a domestic animal. He is still wild. The diversity of his nurture is such that no horse-breeding industry would tolerate for an hour without risk of bankruptcy.

Human behaviour, as we observe it in the sciences of man, varies within certain limits. It is limited on the one hand by the fact that all individuals are produced by a biological mechanism, on the other by the nature of the environment in which individuals are born, live, and move. The scientific study of the limits dictated by the processes of sexual reproduction is called *genetics*, and is comparatively new. In spite of this, genetics is a more exact science than the traditional sciences of society. Partly for this reason there is a great deal of current exaggeration concerning

the contribution genetics can make to a constructive policy in public hygiene and education. In fact, we have not yet been able to find an environment in which any observed *psychological* trait behaved as if it conformed exactly to the numerical requirements of genetic laws. This does not mean that heredity is of no account in human behaviour. It means that environmental conditions are also casual agencies in the trait as we observe it, and that our methods of disentangling nature and nurture are still imperfect.

2. SOME COMMON MISCONCEPTIONS

The meaning of the nature–nurture problem is still very inadequately understood by partisans on both sides. One basic error is to speak of some characteristics as inherited and of others as environmental. Modern genetics no longer concerns itself with " inherited characteristics." Every characteristic is the result of interaction between the hereditary materials present in the egg and the sperm on the one hand and the environment on the other. When a characteristic of one individual *differs* from that of another, the *difference* may be wholly due to the fact that the two individuals receive different hereditary materials or *genes* from their parents, wholly due to the fact that the same genes exercise their effect in different kinds of environment, or to the combination of other sources of variation. The difference between Miss Smith who can play the piano and Miss Jones who cannot may be wholly due to environment, since playing the piano presupposes having access to one. The difference between an albino and a person who is not an albino is wholly due to heredity, since there

is good reason to believe that the genes which distinguish the two types will exert their effect in all known types of environment compatible with healthy existence. No differences of social behaviour belong to this category.

A second error is to speak at large of the relative *importance* of heredity and environment. In fact, the one term is the correlative of the other. Their co-ordinate importance is or ought to be axiomatic. Of course, nature-differences may account in a particular case for more of the observed differences between individuals than differences due to nurture, or vice versa. Especially when we are thinking in terms of social policy, either nature or nurture will be the strategic point of attack. The consequences of this way of looking at the issue are sometimes surprising. Assume that we raise the environment of all to equal that enjoyed to-day only by the fortunate minority. Two things will follow. First there will will be a rise in the average level of human performance. Second we shall bring about a state of affairs in which all or most of the remaining differences between individuals in respect of the trait in question will be due to hereditary differences. In such a society the relative emphasis will rightly shift from nurture to nature. But it would be very foolish to assert that heredity is therefore more *potent* than environment. It is simply more *topical*. In a real sense the aim of environmentalists is to work towards a state of society in which heredity, not environment, plays the supreme rôle in determining such differences as continue to exist between individuals or social groups. Teachers and social reformers need not be distressed at this result

when it comes about after an exhaustive trial of measures to improve the environment. Indeed, it is the greatest possible compliment to their efforts.

The same remarks apply, *mutatis mutandis*, to the work of eugenists. In stock-raising and horticulture our present aim is to raise the average level of animal and plant heredity by selective breeding.[1] To the extent in which we succeed in this task, the residue of differences in the observed qualities of animals and plants will be increasingly the result of environmental differences between them. If this were to happen the efforts of agriculturists would be devoted mainly to improving the environment. Heredity would not have ceased to be important, although it would no longer be the focal point of agricultural policy.

If we recognize the real meaning of the nature–nurture problem we may not lose our political tempers so easily. A real difference separates eugenists and social democrats. But the controversy has always been to some extent artificial. No sensible environmentalist ever wasted his time trying to turn idiots into geniuses. By implication he has always admitted that heredity sets limits to the efficacy of his proposals. Similarly the eugenist, although he is hardly aware of the fact, devotes an inordinate amount of his time and energy to efforts to change the social environment. His propaganda is designed to put new laws upon the statute book. His proposals for

[1] In passing, it may be said that the standardization of the environment by winter root-crop storage was a necessary prelude to the recognition by eighteenth-century stock-breeders of standards of excellence.

sterilizing the "unfit" represent the most extreme form of environmental interference ever contemplated.

Thus the so-called environmentalism of the eighteenth and nineteenth centuries reflected the relative strategic superiority in that period of measures designed to improve the social environment of nations. Environmentalism was an appropriate philosophy, since it worked. Nowadays the tendency in certain quarters is to emphasize rather the need to raise the level of the nation's stock. Nobody would complain of this change of front if in fact we had pushed environmental improvements to the margin of profitability. The reaction against the kinds of social reform initiated by eighteenth-century Liberalism, and advocated in much greater measure by socialists to-day, is not based on any agreed objective assessment of present facts and possibilities. To an overwhelming extent it is due to the reluctance of the privileged classes to meet the high money cost of an adequate provision for the welfare of the masses, and to their fear of competition from below.

3. MEASURING YOUR HEREDITY

It is freely stated by many psychologists that "intelligence is wholly or mainly inherited." We have seen that, cast in this form, such an assertion is scientifically meaningless. Firstly we have no means of measuring an individual's "total" intelligence. We only know how individuals resemble or differ from one another in intelligence. A difference of twenty points of I.Q. between two individuals may be due wholly or partly to a genetic difference between them, wholly or partly to an environmental difference.

Secondly we do not know the "total" heredity of an individual, nor his "total" environment. We must beware of confusing biological inheritance with legal inheritance. It is not difficult to ascertain how many pounds your father has left you in his will. We have no way of discovering how many and what kind of genes your parents have endowed you with. For example, *recessive* genes are borne on one member only of a chromosome pair, and do not produce any anatomical or behaviour characteristic that can be seen in an individual's lifetime. Nevertheless they are part of his biological inheritance. He transmits them to his offspring, and under certain conditions they will be manifested in one or more of his remote descendants. Pedigrees as lengthy as those of the oldest families represented in the House of Lords cannot help us to enumerate all the genes that lie on the chromosomes of any given individual. In the same way as I.Q., the heredity of an individual is a comparative concept. We can specify A's heredity only by saying that it resembles more that of a second individual B than it does that of a third individual C.

For example, if we compare you with any other individual selected at random from the population, the pair of you are as little alike as you are likely to be. If you are first cousins, you will obviously be rather more alike than if you are entirely unrelated to one another. You share common grandparents. If you are *siblings—i.e.*, if you have the same parents—you will be more alike than if you were first cousins. If you are identical twins, you will be as alike as any two individuals could possibly be. Thus we can ob-

tain knowledge about the heredity of individuals by grouping them into certain classes distinguished by possession of the same degree of genetical relationship. Instead of *specifying* "total" heredity, we *contrast* individuals on the basis of the amount of resemblance or difference in genetic constitution which they possess.

Similarly we do not know how to enumerate all the environmental factors in the life of a given individual. We can say, however, that all individuals who belong to families of ten children resemble each other with respect to the environmental factor known as family size, and that all children whose fathers are wage-earners resemble each other in respect of the occupational status of their parents. It is convenient for some purposes to divide environmental differences into two kinds: (*a*) inter-family or socio-economic differences like income, cultural or occupational status, or parental intelligence; and (*b*) intra-family differences—*e.g.*, order of birth, maternal age, family size, and a great many other factors in the configuration of the family which we have no present means of measuring.

The issue discussed in this and the following chapter can therefore be put as follows. In testing individuals for intelligence, differences are found between them. What part of these differences is due to differences in their genetic constitution and what part to differences in their environment? Genetic differences may be of two kinds: (1) differences which are recognizable in almost any environment in which the fertilized egg will develop and continue to grow; and (2) differences which are manifest only

within a fairly restricted range of environment. If the statement that " intelligence is wholly inherited " has any meaning at all, it must mean that intellectual differences belong to the former class—*i.e.*, that they can be detected in any environment in which an individual can live. It must also mean that differences in environment are not causally related to differences in intelligent behaviour. Stated thus the issue is amenable to further inquiry.

4. ENVIRONMENT AND INTELLIGENCE

It is probable that comparatively great variations of environment, as we conceive them to-day, do not produce correspondingly great variations in intelligent behaviour. We do not find that if the income of a family is doubled the intelligence of its members is also doubled. Possibly the entire range of intellectual variation in respect to environmental variation is very small. We do not know. But that is not the point at issue. The observed differences between the average I.Q. of different socio-economic groups are comparatively small. Are they wholly or mainly due to racial differences between the groups, or to differences in their environment? If environmental variables have any effect, however small, we may hope by appropriate social reforms to reduce the intellectual differences that at present separate the social classes. All we want to know is if the recorded discrepancies between different sections of the community are racial or institutional in origin. Even if variations in intelligence in response to environmental changes are small compared with those elements in intelligent behaviour which remain unaffected by such changes, there is no

reason why we should be pessimistic. There are few to complain that the intellectual level of the prosperous classes is not sufficiently high. The fashionable assertion is that the mentality of the masses is too low. If we could reduce the discrepancy between the two sections of the community we should be doing a great deal.

Those who are dubbed "environmentalists" are not so stupid as their opponents make them out to be. They do not assert that the level of human intelligence can be indefinitely raised by successive improvements in the standard of living. They are ready to admit the possibility that above a certain level further increases merely in socio-economic advantages would produce no significant increments of intelligence. They are quite prepared to believe that differences in intelligence occur within a comparatively restricted range of environment. At the present time most people would be happier if they had more money. We do not therefore argue that the more money they have, the happier they must be.

It used to be thought that the examination of family histories like those which throw light upon the inheritance of clear-cut physical defects could also give us information about the contribution of heredity to social behaviour. Great play was made with families which produced a long line of geniuses and others which produced a long line of idiots. Modern geneticists are increasingly suspicious of the utility of studying pedigrees which embody a community of traditions as well as a community of ancestry. The family now known as Windsor has produced a long line of kings. Certain families studied by Goddard

in America and by Lidbetter in England have produced large numbers of idiots. Lidbetter appears to believe that most families which are chronically in receipt of public assistance are of inferior racial stock. The British royal family is in a different sense chargeable to public funds. This fact is not due to any genetic mechanism, but to the legal arrangements whereby family descent is associated with the privileges of royalty. In other words, if one family produces a long line of geniuses, another a long line of kings, and a third a long line of idiots, the result may be due as much to environmental as to genetic causes.

To-day some progress is being made in elucidating the nature–nurture issue, so far as it affects intelligence, by methods not open to the same criticisms. There are three principal types, one of which is described here. The other two belong to the next chapter.

5. MENTAL AND PHYSICAL WELFARE

We can take two groups of children, drawn from an environment as homogeneous as possible, each displaying the same average level of test-intelligence. We proceed to introduce a new or " training " factor to one group, leaving the other as it was. We then compare at various intervals of time the intellectual performances of the experimental group with that of the controls. Four general conclusions emerge from these and similar studies. (*a*) Changes in schooling are less powerful than changes in the economic and cultural character of the home in producing I.Q. differences. (*b*) Changes experienced after the age of 5–7 are less significant than those occurring in the

formative period of infancy and early childhood. (*c*) When changes are made, they must be maintained over a period of years to effect a durable alteration in I.Q. (*d*) With the exceptions of lesions, certain toxic conditions, and some diseases or injuries of the central nervous system, differences in physical conditions like illness, accident, or malnutrition do not result in any measurable differences in test-intelligence.'

As a variant of this method, we can compare normal children with children characterized by the possession of some easily-identifiable trait. Dawson and Conn, working in Glasgow, found no impairment of test-intelligence associated with chronic illness in general, nor specifically with chorea and the Parkinsonean syndrome, spinal, or even localized cerebral diseases. Even encephalitis lethargica (sleepy sickness) does not invariably result in mental retardation, though epileptic patients are generally dull. Nor are diseased tonsils or adenoids or simple glandular deficiencies intellectually disadvantageous.

Blanton investigated the intellectual effects of the profound malnutrition suffered by German children in the later years of the War and blockade. His methods were not rigorously scientific, but his main conclusions have not been challenged. He found that not more than 5 per cent. of school-children received permanent intellectual scars. On the other hand, children from poorer homes and of lower initial intelligence suffered more than the rest. This suggests that nutritional differences are associated with intellectual differences *below* a certain level of nutrition. Above it, nutritional differences exercise

comparatively little effect. In this country we know that a low level of nutrition is associated in general with an average I.Q lower than that of children from prosperous homes. By itself this proves nothing, since it may be that the poor are badly nourished because they are not clever enough to earn a decent living. On the other hand, it may be that many children have a diet inadequate for the proper growth of intelligence. Apparently an improved diet can add three inches to the height of children. May it not be possible that it also increases their intellectual stature? It is a pity that current controversies about the effects of malnutrition have not hitherto led to any attempt to investigate this issue in a scientific way.

This method of approaching the nature–nurture problem has obvious limitations. It is not entirely unexpected that a great number of bodily factors do not affect intelligence. Intelligent behaviour is pre-eminently that which involves the activity of the central nervous system. As such, it is much more likely to be influenced by social and cultural than by somatic factors. Moreover, no one imagines that any social and cultural change, however small, need produce a measurable change in test-intelligence. It is exceedingly difficult by artificial "training" to introduce changes massive enough to affect human ability. Occasionally they occur in nature, and we are fortunate to have some studies which compare children before and after their exposure to a substantially different environment. These will be discussed in the following chapter, along with the case of twins.

CHAPTER IX

TWINS: THEIR USES AND ABUSES

1. THE OCCURRENCE OF TWINS

As all the world knows nowadays, twins are of two kinds, identical and fraternal. Identical or monozygotic twins are believed to be the result of the fertilization of one ovum by one sperm. A single embryo at a very early stage in its development divides into two separate embryos, each complete in itself, so that both new individuals have the same chromosome constitution. By contrast, fraternal or dizygotic twins are the result of the simultaneous fertilization of two different ova by two different sperms. The two embryos share the same uterine environment and may later share the same family environment, but biologically they are independent from the very moment of conception. In genotype fraternal twins are no more alike than any pair of siblings need be, and these, as we all know, may often be widely different. Identical twins are necessarily of like sex, since sex is determined by the presence of the X or the Y chromosome in the sperm of the male parent, and each co-twin is derived from one and the same sperm. Fraternal twins like ordinary siblings may be of the same or different sex, since the eggs from which they come are fertilized by separate sperms.

Twin births occur about once in every eighty births. Since the numbers of the sexes are ordinarily kept almost equal by the working of the XY chromosome mechanism, boy–boy, girl–girl, and boy–girl pairs of fraternal twins should occur in the ratio 1 : 1 : 2. So if all twins were fraternal, 50 per cent. would be like pairs. Actually twins of like sex are disproportionately numerous, being about 62 per cent. of the total. This means that about 25 per cent. of all twins are identical. It is well to remember that not every like-sex pair are monozygotic.

Other kinds of multiple births occur even more rarely. For example, the odds against having five children at one birth are 57,000,000 to 1. The Dionne family has recently produced quintuplets, all girls. The table on the next page shows all the possible types of births which they may represent, together with the possible combinations of the five individuals for each type.

Since they are all of the same sex, the odds considerably favour the possibility that they belong to one or two identical series; but, in the absence of data concerning the frequency of the different combinations, we have no method of assessing the probabilities with any exactness. The St. Neots quadruplets consist of three boys and a girl. This means that they must have resulted from the fertilization of at least two ova. The patriotic reader can work out for himself the various possibilities in this case.

If it were possible to find a large number of identical twins separated at birth or soon after, and subsequently reared apart in sufficiently different environments, we could obtain evidence of the greatest value bearing

TABLE VI

THE DIONNE QUINTUPLETS

No. of Embryos.	Types of Births.	No. of Possible Combinations of Quins A, B, C, D and E.
1	5 identical quintuplets .	—
2	(*a*) 4 identical quadruplets and 1 single birth .	5 (*i.e.* any of the 5 could be the single birth.)
	(*b*) 3 identical triplets and 2 identical twins . .	12
3	3 identical triplets and 2 fraternal twins . .	12
4	2 identical twins and 3 fraternal triplets . .	12
5	5 fraternal quintuplets .	—

on the issue of nature and nurture. The public takes a great interest in experiments of this kind, but not to the extent of encouraging the deliberate separation of twins in the interest of science. Even in the U.S.S.R., which maintains a large institute mainly devoted to the study of twins, the recorded cases are very few. In the entire world less than twenty pairs in all have been studied. In these circumstances it is impossible to dogmatize concerning the results obtained by this method of tackling an age-long controversy. For a series of less than twenty, not all tested in the same way, averages mean very little.

Looking at the figures, we obtain the impression tha the tendency is for the separated twins to resemble eacl other less than twins reared together, the larges discrepancy recorded being 18 points of Stanford Binet I.Q. In very few cases did the economi and cultural environments of separated pairs diffe strikingly. The interpretation of the results is als affected by the fact that some were tested when adult

2. THE INTELLECTUAL RESEMBLANCE OF TWINS

It has been more usual, therefore, simply to compar the observed differences between different classes o genetically related pairs, twins, siblings, cousins, etc. brought up in the usual way, with the differences expected on a purely genetic theory of the agencies which affect intellectual resemblance. If differences in intelligence are due exclusively to differences ir heredity the amount of resemblance between the intelligence of related individuals should be the same as that predicted by the appropriate genetic theory. On the other hand the observed resemblance may be partly due to similar environment. Thus we could be sure of our conclusions only if we also had some reliable method of specifying the amount of environmental resemblance holding between genetically related individuals. Unfortunately this is not easy. Members of the same family share a similar environment. Siblings born at the same time have an even more similar environment. First cousins usually belong to the same social group. As yet we have no means of estimating how the environment of one member of a related pair resembles or differs from that

of the other. For this reason studies of the intellectual resemblance between relatives are inconclusive.

All existing studies using intelligence tests go to show that identical twins resemble each other much more than any other kinds of pairs. We do not expect that two identical twins will always have exactly the same I.Q., but if we take a large number of them, we find that the average intra-pair difference in a group of identical twins is considerably smaller than the average difference between other paired individuals, whether related or not. Table VII

TABLE VII

MEAN INTRA-PAIR DIFFERENCES IN I.Q. FOR TWINS, ETC.

(a) *Otis Test*

	Mean Differences.	No. of Pairs.	Authors.
Identical Twins .	9·2	65	Herrman and Hogben
Fraternal Twins .	17·8	234	do.
Siblings . .	(1) 16·8	103	do.
	(2) 17·2	297	Gray and Moshinsky
First Cousins .	20·5	314	do.
Test-retest (same individuals) .	12·2	100	do.

compares the mean intra-pair differences in Otis Test I.Q. of identical and fraternal twins, siblings born at different times, and first cousins. It also shows the mean differences to be expected when we test the same group of individuals twice running,

with an interval of about a year. Table VIII gives the same kind of information based on the use of the Stanford–Binet Test. The absolute size of the differences is not the same when we use different tests, but their order of magnitude is remarkably alike. Looking at the two tables, we can see that one identical twin resembles his twin-mate more than the average

TABLE VIII

MEAN INTRA-PAIR DIFFERENCES IN I.Q. FOR TWINS, ETC.

(b) *Stanford-Binet Test*

	Mean Differences.
Identical Twins Reared Together . .	5·9
Fraternal ,, ,, ,, . . .	8·4
Identical ,, ,, Apart . . .	7·7
Siblings Reared Together	14·5
,, ,, Apart	15·5
Unrelated Pairs Reared Together in Orphanages	17·7
Unrelated Pairs Reared Apart . . .	17·7
Test-retest (same individuals) . . .	6·8

individual "resembles himself" when tested on different occasions. Secondly, as the degree of genetical relationship diminishes, average differences in I.Q. increase. To be sure, this increase also corresponds with increased dissimilarity in environment.

In view of these facts it is impossible to hold that intellectual differences between people are incapable of an orderly explanation. There is a popular view fostered by some physicists that the behaviour of

atoms is "indeterminate." Haldane has calculated that the indeterminacy of I.Q. is a good deal less than that postulated by certain physicists for the atom. He wittily concludes that on this showing man has less "free-will" than the atom. However we look at it, the way in which we resemble or differ from other people depends on how closely we are akin to them and how nearly our environments are the same.

3. THE IMPORTANCE OF FRATERNAL TWINS

How much light do these observations throw on the nature–nurture issue? We cannot conclude that nature is paramount simply because identical twins are less different in intelligence than fraternal twins. The environment of the former may also be more alike than that of fraternal twins. In a certain sense an organism selects its own environment. In artificial laboratory conditions a gene may manifest itself in some simple anatomical or physiological peculiarity. In nature, on the other hand, this peculiarity may bring the organism into situations which reveal genetic differences of other kinds that would not be manifest under uniform standardized conditions. In other words, the environment of fraternal twins might well be less similar than that of identical twins, even though the former, like the latter, are born at the same time. For this reason it is possible that environmental differences may play some part in the recorded I.Q. differences between fraternal twins.

The three most important twin investigations are those of Tallman (1928) and of Holzinger (1929), working in the U.S.A., and of Herrman and Hogben (1933), who examined no less than 400 pairs of London

twins. These studies agree in showing that the averag differences between the I.Q.'s of children born in th same family are reduced by about one half when as with identical twins, all hereditary differences ar eliminated. An identical heredity does not abolis intellectual differences between individuals. How ever, it reduces them to negligible proportions. I will be seen from Table VIII that when identica twins are reared apart, their average I.Q. difference are somewhat greater than when they are reare together. This applies also to siblings reared apart Here we have a measure of the contribution of environ mental differences to differences in intelligence.

As we have had frequent occasion to observe averages do not tell the whole story about a series o figures. To get another aspect of the similarity, w need a measure of *variability* which emphasizes larg differences between individuals, since identical here dity is less likely to be associated with strikin differences between individuals than dissimilar here dity. The standard deviation is a suitable index fo this purpose. When variability is measured by thi test, we find that on the whole identical twins ar never so much unlike as fraternal twins can be. Thi result is open to more than one explanation if it i true that, even when they are of the same sex, th environment of fraternal twins differs more than tha of identical twins. Whichever method we use fo comparing the variability of twins, the results poin to the conclusion that nurture is much more effectiv in producing intellectual differences than in pro ducing physical ones. The intelligence of humar beings, however much it may be influenced by here

dity, fluctuates in response to environmental changes to a greater degree than characteristics like eye-colour and stature.

Another method of interpreting twin data involves the use of a mathematical device known as the coefficient of correlation, or "*r*" for short, to which a brief reference has already been made in Chapter III. To understand it let us imagine that we are investigating a relationship alleged to exist between the height and the weight of individuals. We may suspect that, as a rule, the taller an individual is, the heavier he is. How are we going to establish whether this is true or not? Ordinary observation will not carry us very far, since we cannot easily judge what importance to attach to the apparent exceptions. Firstly we would collect a series of figures for both the weight and the height of a large number of individuals. Looking at them in the ordinary way, we might say that the correspondence of height and weight was "nearly perfect," "fair," or "rather low." Correlation technique affords us a method of putting a numerical value on the degree of correspondence between the two series of figures, inadequately conveyed by the use of verbal language. Perfect correspondence is represented by 1, no correspondence at all by zero. $r = 0{\cdot}5$ would mean that the correspondence was half-way between zero and 1. (It does *not* mean that half the individuals follow this rule and half do not.) If the sign is negative, it means that the *larger* the score individuals possess for trait A, the *smaller* is the score for trait B.

In recent years the method of correlation coefficients has also been applied to the comparison of pairs of

individuals with respect to the same trait. Given certain assumptions, it is possible to calculate the amount of resemblance in genetic constitution between pairs of individuals related to one another in a certain way. If we take a large group of sibling pairs—*i.e.*, children born to the same parents—we can say that *genotypically* they correlate to the extent of $r = 0{\cdot}5$. In other words, the genes which one sibling inherits from his parents and which he will afterwards transmit to his offspring do not correspond perfectly with those of his fellow sib, nor are they completely different. The correspondence between them is four times as great as that between first cousins, whose genotypic correlation value is $r = 0{\cdot}125$. It is only half as much as that of identical twins, who resemble each other, of course, to the extent of $r = 1{\cdot}0$. We can therefore rank different classes of related pairs in order of their genotypic resemblance, expressed in numerical terms.

Table IX compares the *genotypic* resemblance of certain types of relatives with their *observed* intellectual resemblance as measured by I.Q. As we should expect, the observed intellectual resemblance of identical twins is much greater than that of any other type of related pair. In general, the order in which the values of r descend is the same both for I.Q. and genotype. But there is one significant exception to this statement. Genotypically fraternal twins have the same status as ordinary siblings born at different times. Intellectually, on the other hand, they are much more alike than siblings. No purely genetic theory could account for this discrepancy. The greater I.Q. resemblance of fraternal twins when compared with ordinary

siblings can be due only to the fact that their environment is more similar.

From the standpoint of social psychology it is not difficult to understand why this should be so. Two fraternal twins share the same uterine environment and the same stage in the family fortunes. They are more likely to share the same type of physical and social routine than sibs born at different times. The

TABLE IX

COMPARISON OF GENOTYPIC WITH OBSERVED CORRELATIONS FOR I.Q.

Otis Test

	Genotypic. r =	Observed. r =
Identical Twins . . .	1·0	0·86–0·92
Like-sex Fraternal Twins . .	0·5	0·47–0·63
Unlike-sex Fraternal Twins . .	0·5	0·53–0·75
All Fraternal Twins . . .	0·5	0·5–0·7
Siblings	0·5	0·37–0·5
First Cousins	0·125	0·16

latter may come at different periods in the family fortunes, benefit to a different extent from the experience of their parents, and may be housed in a uterine environment conditioned by different states of maternal health. Indeed, it would not be surprising if studies of sib resemblance based on samples from different communities on different social levels led to different results. We must remember that the comparative constancy of the I.Q. between the ages of 5 and 15 affords no presumption concerning the differential

influence of environmental agencies which operate *in utero* or during the earliest and most formative years of childhood. In a period of prosperity, or in a social group experiencing a rise in standard of living, the environment of later-born children may be more favourable than that of first-born. Conversely, in times of depression, or in a group with no prospects of economic advancement, the environment may be less favourable for later-born children. These considerations do not affect fraternal twins.

Such evidence as we have from the use of correlation studies confirms the view already expressed that neither an extreme autogenetic nor an extreme environmentalist standpoint does justice to the facts of intelligent behaviour. These facts, however, do not enable us yet to construct a quantitative index of the respective contributions of nature and nurture differences to intellectual differences. They have limitations of another kind. The genotypic values set out in Table IX make certain assumptions concerning the type of genetic transmission involved and the different probabilities of various kinds of matings. Assortative or selective mating (like marrying like) may in certain cases raise the correlation between sibs and in others lower it. Even when we take very large groups we cannot be sure that mating tends to be at random. It is often very difficult to guess the exact mode of hereditary transmission for any observed trait.

It is also incumbent upon us to bear in mind another issue. Differences of environment which tend to increase the difference between two members of the same pair *lower* the correlation in a group,

while environmental differences tending to increase the differences between different pairs *raise* it. The way in which we select relatives to determine the correlation coefficient for intelligence may be such that the effect of environmental differences between one pair and another balances the differences between two individuals of the same pair. In this way we might account for the higher correlation observed for the I.Q. of fraternal twins, compared with sibs, and for the fact that Freeman, Holzinger, and Mitchell found the correlations between own and adopted children in foster homes to be of a similar order of magnitude to those between sibs adopted into different homes at birth. In the study of nature and nurture it is essential to experiment with groups of a uniform environment. As will be seen in the next chapter, there is still some doubt about the significance of differences in birth rank within the same family and between related pairs drawn from different families. Until this problem is overcome the nature–nurture issue cannot be conclusively settled.

4. STUDIES OF FOSTER-CHILDREN

While twins reared apart are not very common, it is less unusual to find children of the same parents educated in different homes. In the U.S.A. the practice of adoption is well established, and foster-parents belong to many different social levels. In 1928 Freeman, Holzinger, and Mitchell made an extensive study of the intelligence of foster-sibs brought up in different homes in Chicago. This study remains the most important contribution to our knowledge of

the nature–nurture issue. Their conclusions can be summarized as follows:—

(i) When children were tested before being placed in foster homes at an average of 8 years, and re-tested 4 years later, they gained on the average 7·5 points of Stanford-Binet I.Q. It is only common sense to attribute their increased intelligence to the fact that the foster homes into which they were placed were considerably superior socially and culturally to their original home environments.

(ii) The increase was not uniformly distributed. Children put into very superior foster homes, ranked on a special socio-cultural scale, gained substantially more than those adopted into inferior homes.

(iii) Children adopted into a family at an early age and " own " children of the foster-parents were found to resemble each other to the extent of $r = 0{\cdot}25$–$0{\cdot}37$. The earlier the age of adoption, the greater was the extent of this similarity. In other words, had the adopted children not been known to be such the intellectual resemblance between them and their foster-sibs would have suggested that they were genetically related.

(iv) In certain cases siblings had been adopted into different families. On re-testing they were found to resemble each other less than do siblings who have been reared together. When the comparison was limited to those who had been placed in foster homes of widely differing social and cultural status, the correlation fell to $r = 0{\cdot}19$.

It would be rash to infer that these data, however interesting they are, are in any sense conclusive. Different investigators often reach very different results.

even when repeating what seems to be the same experiment. We cannot find evidence of environmental effects if no changes of environment take place. The Chicago foster-children grew up in a period of expanding prosperity in the U.S.A. London children to-day have lived all their lives in a period of depression. In general, environmental agencies affecting working-class children are less visible in England than in America, where social mobility was until recently comparatively great.

CHAPTER X

INTELLIGENCE, SOCIAL CLASS, AND THE FAMILY

> " Experience, in all ages and in all countries, has demonstrate that it is impossible to control nature in her distribution o mental powers. She gives them as she pleases. Whatever i the rule by which she, apparently to us, scatters them amon mankind, that rule remains a secret to man. It would be a ridiculous to attempt to fix the hereditaryship of human beaut as of wisdom. Whatever wisdom constituently is, it is like seedless plant; it may be reared when it appears, but it canno be voluntarily produced. There is always a sufficiency some where in the general mass of society for all purposes; but witl respect to the parts of society, it is continually changing it place. It rises in one to-day, in another to-morrow, and ha most probably visited in rotation every family of the earth, an again withdrawn."

WE do not know if Paine's historical generalizatior is correct. If it suggests that the social distributior of intelligence to-day is wholly arbitrary and capricious it is certainly not true. We have evidence that there are marked differences between the average intelligence of various social groups. There are two reasons why these differences should have a chapter to themselves. Firstly their extent is often grossly exaggerated; and secondly they are often attributed mainly to differences of a genetic kind between social groups, an assumption for which we have no reliable independent evidence. As we have seen, the presence of mean

differences in intelligence between different groups cannot by itself throw any light upon their genetic or environmental origin. Two poor children with I.Q.'s of 70 and 130 respectively will in most cases differ for mainly genetic causes, as would two children from prosperous homes who showed a similar inequality. But the difference between the *average* I.Q. of poor and prosperous children is not so certainly caused by class differences in average genetic endowment. Few believe that social classes are arranged on a purely hereditary basis. In western countries there are no castes exclusively recruited in each generation from the same families. This is not to deny that the effect of selective mating within social groups does not make them relatively homogeneous and thus increases the genetic differences between them. However, until we know to what extent selective mating takes place we have no means of making any estimate of such part of the intellectual homogeneity of social classes as might be due to their internal genetic resemblance. Further, we are not entitled to believe that the factors which produce a social hierarchy result in a corresponding hierarchy of intelligence. Intelligence is not the only quality which ensures social promotion. In many cases it is the least important. Conversely, there are many occupations of comparatively low social status which require high intelligence—*e.g.*, clerical employments. For this reason we cannot expect that the mean I.Q. of different occupational groups should rise *pari passu* with increasing socio-economic status as judged by other criteria like income, prestige, etc.

From the standpoint of genetic psychology socio-

economic groups are even more ambiguous categories than contrasted groups of related individuals like twins and sibs. There are many social differences which nobody in his senses would regard as genetic in origin, such as differences in inherited wealth, accent, educational opportunity, and many social habits. Recently we learned from Sir John Orr's investigations that differences in the mean stature of individuals are to a large extent social differences depending on nutrition. Until we prove that intelligent behaviour is unaffected by environment, it would be rash to assume that I.Q. differences between social classes are evidence of a genetic difference between them. Since identical twins brought up in the same family have an environment more nearly the same than any other pairs of individuals could have, the mean difference between their I.Q.'s represents the *minimum* contribution made by environmental differences. The fact that the mean differences between occupational groups are often several times greater does not therefore disprove the possibility that they are largely environmental in origin.

1. INTELLIGENCE AND OCCUPATION

Most investigations into social differences in intelligence take the form of applying tests to children classified according to the occupation of their parents. They lead to results which are remarkably similar both for Great Britain and the U.S.A., in spite of the considerable disparity in the social structure of the two countries and of local inequalities within each. Judged by intelligence tests applied to children, it would appear that there is a configuration of

social relationships everywhere characteristic of industrial capitalism in the present century. The latest study dealt with 10,000 London children classified in eight socio-economic categories according to the occupation of their parents. In descending order of mean I.Q. these groups were as follows: (i) Professional, (ii) Larger Business Owners and the Higher Executives of Business, (iii) Clerical and Commercial Employees, (iv) Minor Professional and Other Highly Skilled Workers, (v) Shopkeepers, (vi) Skilled Manual Workers, (vii) Smaller Business Owners, and (viii) Unskilled Manual Workers. This agrees fairly closely with the majority of other English and American findings. All students of the problem report wide variability within each occupational group examined, with the exception of Unskilled Workers, who are intellectually a comparatively homogeneous group. When the figures "spread" a great deal, averages cease to give us any reliable information about the central tendency of groups, and have little diagnostic value. In a great many cases single occupational groups show a much higher or a much lower mean I.Q. than the average of the socio-economic category in which they have been put.

For example, in the London enquiry it was shown that the children of Advertising Workers, Insurance Agents, Seamen, Engineering Draughtsmen, and the Clerical Grades of the Civil Service exceeded the average of the class ranked highest in average intelligence—namely, Professional Workers. On the other hand, certain professional occupations—*e.g.*, Ministers of Religion—were much below the average of their group. Clerks, Tailors, Chauffeurs, and the rank

and file of the Armed Forces exceeded the average of the class of Large Business Owners. The children of Brokers, Jobbers, and Financiers ranked comparatively low, while Farmers were not much above the average of Unskilled Manual Workers. The study of these and similar interesting facts suggests the following conclusions :—

(i) In many of the occupations ranked very high in intelligence the parents have been selected by competitive examinations. Together with the superiority of the professional class as a whole, this fact sets definite limits to the hypothesis that intelligence and socio-economic status are correlated at every point in the social scale. Measured by a purely pecuniary canon or in terms of the influence they exert in public life, the class of wealthy business men stands highest in the social hierarchy. Nevertheless their children are nowhere reported to have a higher I.Q. than those of Professional Workers, even of school-teachers whose income and social status are comparatively low. With greater equality in educational opportunity one would expect to find numbers of children from every social class, who had been selected by their proficiency in passing competitive examinations, in occupation of high professional positions. In consequence there might be an even wider gap between the mean I.Q. of this class and of that immediately below.

(ii) It is reasonable to suppose some correlation to hold between the test-intelligence of parents and their offspring. Thus the high level reached by the children of clerks may be explained partly in terms of selection for intelligence within the industrial population, among whom black-coated workers enjoy

considerable prestige. It may be also that clerical abilities are highly correlated with whatever is measured by intelligence tests.

(iii) Irrespective of differences in status and remuneration, certain callings seem to select individuals of much the same level of intelligence, or, more accurately, they tend to produce much the same level of intelligence in the filial generation. A great gulf separates the officers' mess from the canteen. Yet the average I.Q. of the children of officers and private soldiers is very similar. The figures for shopkeepers, shop managers, and shop assistants are practically identical. So are those for civil servants of every grade.

(iv) The children of manual workers occupied in mechanical road transport, the public services, the newer and more flourishing industries, and in crafts requiring apprenticeship or learnership are more intelligent than other manual workers. Examples of comparatively high I.Q. are the children of tailors, seamen, chauffeurs, wireless operators, stage hands, police constables, metal-trade workers, transport and postal workers, and electrical engineers. On the other hand, children of railway employees, building-trade workers, and printers occupy a relatively low position. Building suffers from irregular employment and trade depression. Both in this industry and in railway transport employment is non-progressive. It looks as if employments which are not expanding and whose technique shows little change do not attract men of high intelligence. However, it must not be forgotten that other circumstances attending the nature of the work may be partly responsible for the inferior I.Q. of the filial generation.

(v) With the exception of certain classes of workers in the hotel and catering trades, no unskilled workers' children exceed the mean for those of skilled workers. It is already well known that unskilled workers form a much more homogeneous group socially than skilled workers. Their mobility is less; so is the variety of their employments. Their social habits are probably less elastic. Intellectually also they display less variability than any other socio-economic group.

(vi) In interpreting the data described above, one possibility has not yet been discussed. It may be that intelligent behaviour is stimulated to a high pitch of performance in occupational groups engaged in the rapid ascent of the social ladder. Where the conditions of mobility are present, individuals selected for other qualities as well as intelligence will often make exceptional efforts to promote the social advancement not only of themselves, but also of their children. On the other hand, when people have achieved a comparatively high economic status and have ceased to feel precarious, these efforts may slacken. It is clear that lack of opportunity to rise out of their class must deaden the response of unskilled workers' children to intellectual stimuli. Environmental differences may be more potent in producing differences in test-intelligence in intermediate groups than in those at the top or the bottom of the social scale.

These are interesting speculations, but they are only speculations. It is extremely dubious to argue from the achievement of children on intelligence tests, designed to test aptitude in the performance of school tasks, to the mental standing of their parents. While it is not improbable, we do not yet

know with certainty that there is any connexion between such performances on the part of the filial generation and the agencies that have led their parents to practise certain occupations.

2. THE STRUGGLE FOR SUCCESS

When we apply correlation methods, the difficulty is equally clear. Correlating social with I.Q. differences, Duff and Thomson obtained a value of $r = 0{\cdot}28$ for public elementary and secondary school children in the county of Northumberland. Gray and Moshinsky found a similar value for their London data regarded as a whole. The latter proceeded to divide their subjects into two groups: pupils educated at the expense of the State, and pupils for whose education their parents have to pay. They found a much smaller correlation between social and intellectual status among prosperous children than among the rest, although the range of occupational differences is manifestly just as wide in the ranks of those with incomes in excess of the elementary school maximum, as among those below it. Above a certain level in the social scale differences both in income and in the nature of the work performed by parents correspond very little with differences in the intelligence of their children. It is primarily among clerical and skilled manual workers that the opposite holds true. They live at a level where great efforts may lead in many cases to an advance in comfort and status which, although small in terms of money, is sufficient to mark the transition from crushing poverty to an environment conducive to hope and ambition. In those

sections of a community where competition and the struggle for " success " are most conspicuous, it would not be surprising to find that significant differences in hereditary equipment characterized different occupational groups. It is highly probable also that these income ranges correspond with those ranges of environment to which intelligence is most sensitive. It would not be far-fetched to say that a rise of average income of a pound or two per week, if maintained sufficiently long, might raise the average I.Q. of those classes by 10 to 20 points.

However this may be, one conclusion is unchallengeable. A correlation of $r = 0{\cdot}28$ is not great. Thus socio-economic status is not highly diagnostic of intellectual level. In spite of the significant mean differences between social groups, a considerable proportion of prosperous children have comparatively low I.Q.'s, and a considerable proportion of poorer children possess high ability. On the assumption that the intelligence of parents is closely associated with that of their children, the figures do not show that selection for intelligence operates at all perfectly in the sorting out of individuals into occupations of high and low social status. This result is in harmony with the facts displayed in the chapter on Ability and Opportunity.

3. FAMILY SIZE AND INTELLIGENCE

At the present time a definite relationship exists between the intellectual standing of an individual and the size of the sibship to which he belongs. Children who belong to large families are on the average less intelligent than members of small

families. Negative correlations of the order of $r = -0{\cdot}25$ are generally reported. The reader who has followed the argument of the preceding pages will not fall into the error of concluding that family size *determines* intelligence. The value of the correlation is only one quarter of the value that would express perfect correspondence between the two series. Thus many children in large families have high intelligence and many in small families have low intelligence. Nevertheless the fact raises an issue of no little importance in the present population crisis. It is interpreted by many eugenists to mean that the poor should be discouraged from multiplying and the rich induced to breed faster by remissions of taxation. This is a curious view. I know nothing which suggests that it is poverty which makes the rich limit their families. Everything points to the belief that a rise in the standard of living of the poor would be accompanied by a fall in their fertility.

Table X on the next page shows how different socio-economic categories produce families of different average size.

The figures refer to children who were between 9 and 12½ years old in 1934. It is possible that the gap is closing up and that recent marriages of rich and poor will not show nearly so great a discrepancy. This table raises a crucial point in the argument. We have already seen that a connexion exists between occupational status and I.Q. There is a similar correlation between family size and I.Q. When we consider that it is the poorer social groups who have the larger families, the question arises whether it is social status or the size of the family that matters

TABLE X

MEAN FAMILY SIZE IN SOCIO-ECONOMIC CATEGORIES

	All Free Pupils (weighted).	All Fee-paying Pupils (weighted).	All Pupils (weighted).
A. *Employing and Directive Classes*:			
1. Larger Business Owners and Higher Executives . .	-	2·59	2·59
2. Smaller Business Owners . .	3·75	—	3·75
3. Shopkeepers . .	3·66	2·59	3·52
B. *Professional Occupations* .	3·28	2·61	2·70
C. *Minor Professional and Other Highly Skilled Occupations* . .	3·31	2·49	2·99
D. *Clerical and Commercial Employees* . . .	3·52	2·19	3·31
E. *Manual Workers*:			
1. Skilled Wage-earners.	4·02	2·30	3·99
2. Unskilled Wage-earners . . .	4·62	2·33	4·61
Mean of All (weighted) .	4·09	2·49	3·96

most. In other words, have children from large families a low mean I.Q. because they come from large families or because they have parents practising certain occupations of inferior social status? Does the negative correlation between family size and I.Q. hold *within* each social class? Taking the group of

skilled manual workers, Gray and Moshinsky find that it does, but to a much smaller extent. Similarly it is very much lower for children attending fee-paying schools than for the school population as a whole. These data suggest that within a comparatively homogeneous social group the tendency for large families to produce offspring of lower intelligence is not marked. As a check the correlation between socio-economic status and I.Q. when family size was held constant was also investigated. It was almost unchanged. The conclusion, though not irresistible, is this: that a great part of the observed negative correlation between family size and I.Q. is not inherently the product of family-size differences *per se*, but of socio-economic differences, which at the present time happen to be accompanied by differences in reproductive habits.

4. THE INTELLIGENT AND RACE EXTINCTION

It is only a very slight intellectual advantage, therefore, to be born into a smaller family, especially if it is a family not conspicuously well-off. But the advantage exists and calls for some explanation. Does it mean that parents who procreate freely are less intelligent than those who limit their families, and thus transmit to their offspring a biological inferiority? Remembering what it is that intelligence tests measure, we ought not to dismiss this possibility. Investigation has shown that *all* children in larger families, irrespective of the order of their birth, are slightly less intelligent on the average than children born to smaller families. Environmentally all first-born children occupy a similar position for at least the first few years of their existence. However, at test-

age the first-born children of larger families are somewhat inferior to those of small families in the same social group. So far as it goes, this fact is evidence for a genetic theory of family size differences in I.Q. However, let us not too hastily condemn those parents who "unintelligently" produce families above the average size. The paradox has already been pointed out in Chapter VI. The higher mean intelligence of small families is caused almost entirely by the remarkable superiority of *only* children. If all married pairs confined themselves to one child, we would witness the edifying spectacle of a race of highly intelligent beings rushing to extinction.

Still, it would be useful to know how we could produce intelligent offspring in families large enough to maintain the population. This is already achieved by such of the prosperous classes as have larger families than the average of their class. The data of Gray and Moshinsky show that the mean I.Q. of children in fee-paying schools would not be greater if a higher proportion of them had come from smaller families. For other sections of the community it would undoubtedly rise a little, hardly enough to justify a crusade against the poor having large families. (Nobody, of course, would discourage attempts to persuade mentally defective parents or those living in slum conditions from having larger families.) In the colossal task of inducing the rich to occupy more of their house room with cradles, eugenists will enjoy the good wishes of the public, but not its confidence. It is time we tried a different policy. The abolition of poverty would almost certainly raise the mean I.Q. of the population

If we are ready with appropriate measures, it will not necessarily lead to a still further shrinkage of the population. Only a higher standard of living and literacy will make it possible for the very poor to practise contraceptive technique. A social policy enlightened enough to perceive this fact will not fail also to see the need to make parenthood more attractive for those who at present have small families or none at all. This is the problem that is discussed by Dr. Enid Charles in her extraordinarily able and interesting book, *The Menace of Underpopulation.*

5. THE CONFIGURATION OF THE FAMILY

Considerable attention has been paid in recent years to the possibility that individuals differ in test-intelligence according to their order of birth within the family. The handicapping of the first-born has been a familiar phrase since the time of Galton. To-day it is recognized that behaviour difficulties and delinquency occur disproportionately often among first-born children. A few years ago an elaborate study by Thurstone and Jenkins, dealing with difficult American children and their normal sibs, seemed to establish that the first-born were also handicapped in test-intelligence. Further, their figures suggested that intelligence increased regularly with successive orders of birth up to the eighth-born. Subsequent American studies have not confirmed their work. In England, on the other hand, preliminary inquiries seemed to point in the other direction. It appeared that the first-born were *more* intelligent than the second, the second *more* than the third, and so on. In this mass of contradictory evidence it is not easy to see

where the truth lies. Previous investigators have failed to disentangle order of birth from family size. Clearly, all children whose order of birth is seventh belong to large families, while first- and second-born children may belong equally to large and to small families. In the case of London children, when allowance is made for the fact that children in large families are somewhat less intelligent on the average than those from small ones, no conclusive evidence of order of birth differences has been found. However significant order of birth may be in the study of emotional and temperamental behaviour, it is by itself of little interest to the student of human intelligence.

This is not to say that the configuration of the family as a whole, to which birth order manifestly contributes, plays no part in producing intellectual differences. An individual's status within the family is a product of the size of the family, his birth rank, the age of his parents, the sex of neighbouring sibs, and the size of the interval between successive births. It may also involve other factors—*e.g.*, the behaviour of the parents at different times in family growth—which we are as yet unable to measure. Attempts to correlate differences in intelligence with differences in the age of the mother at the birth of the child have yielded inconclusive results. A preliminary analysis shows that for first-born children with at least one younger sib, those who are five to seven years older than the younger sib enjoy a slight superiority in intelligence over those separated by three to five years. Next in order of I.Q. advantage are first-born children less than two years older than their younger sibs. Statistically this effect is slight, but its direction

is the same in a number of samples of children drawn from different social groups. It is greatly to be hoped that future investigators will follow up this line of inquiry. In an age of birth control there is great interest in the problem of "spacing" births. We do not yet know all the factors that go to make up the structure of a family. When we do, it may be possible for the psychologist to render invaluable assistance in the urgent task of producing future generations better than ourselves. Seen in this light, it is possible that the task of the intelligence-test movement in stating one set of limits to the social efficiency of individuals is nearing its close. The way is open for social psychology to take up the new problem of the part played by temperament and personality in the life of the nation.

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